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AN INTERNATIONAL CO-OPERATIVE INVESTIGATION ON ELECTRICAL STANDARDS.

The article by Dr. Edward B. Rosa which we print this week will interest and inform our readers on the latest phase of the international standardization of concrete electrical units. The history of this subject, of which the present phase forms an important element, will form a very fascinating theme for some future scientific historian. The first official committee to consider electrical units was created in 1861 by the British Association for the Advancement of Science. This committee adopted the c. g. s. fundamental system, as well as the practical system decimally related thereto. It issued standard ohm resistances as early as 1863, known as B. A. ohm coils. If we define the *order* of precision of a concrete standard, as the numerical exponent, to the ordinary base 10 of the ratio of the quantity to its acknowledged error, then a precision of 10 per cent is a precision of the first order, a precision of 1 per cent is a precision of the second order, and so on. It was shown in 1878 by Prof. H. A. Rowland that the precision of the B. A. ohm was inferior to the second order—about the 1.8th order—a precision much inferior to that employed in the comparative measurement of resistances. About six yars later—in 1884—an international committee decided upon the value of "legal ohm" in such terms as raised the precision of that standard half an order, or to the order 2.3 approximately. At the international electrical congress of Chicago in 1893 the "international ohm" was unanimously adopted under such terms as raised the precision of the standard ohm to the third order.

The precision of international reduplication for the international ohm is, however, considerably greater than the precision of the international ohm with reference to its theoretical value. For engineering purposes it is much more important that different national laboratories should issue standard resistances agreeing with one another to a high degree of precision, than that any one of them should attain a high degree of theoretical precision in its standard ohm with detriment to international uniformity. In October, 1908, an international commission, the organization of which was recommended by the St. Louis Congress, met in London and decided upon the standard ohm, and the electrolytically defined standard ampere, as the concrete basis for all electromagnetic units. The precision of international agreement on volt standards had previously scarcely exceeded the third order; whereas a precision of the third order was demanded in careful laboratory measurements of voltage. In other words, laboratory measurements in the best industrial practice had advanced beyond the limits of international precision. At the London conference of 1908 the mass of mercury in the standard ohm, and the length of its mercury column, were each defined with a precision of the fifth order, or slightly higher. The electrochemical equivalent of silver was likewise defined to a precision of the fifth order. Nevertheless, different skilled observers reproducing the standard ampere under speci-

fications varying but little, may vary in their results by differences of the fourth order.

The work which the present international committee has in hand is therefore of the greatest practical importance, not merely to physicists, but also to engineers. It means preparing jointly such specifications for the standard ohm and ampere as will permit of raising the order of international reduplicative precision in preserving and issuing the standard ohm, ampere and volt. Dr. Rosa expresses the expectation that the fifth order of precision will be reached internationally in the standard ohm. We may hope that nearly as high a degree of international precision can likewise be attained in the standard ampere and volt. The Bureau of Standards deserves great credit for having brought about this international gathering of expert physicists to settle these very important questions. The corresponding national laboratories of England, France and Germany certainly share that credit in sending to us delegates, so well known, for arduous work on this commission. Finally, all electrical engineers, all the world over, owe cordial thanks to the four societies, mentioned by Dr. Rosa, which have contributed so generously to the expense of this undertaking. Meanwhile, we wish all success to the labors of the international delegates in Washington. Every extra tenth of an order in international reduplicative precision which the co-operation of these men can effect will be an added gem to the crown of international applied science.

THE REGULATION OF WIRELESS.

We referred last week in detail to several of the bills for the control of wireless communications which are now before Congress. They represent various points of view, but the purpose of all is the laudable one of so regulating the transmission of wireless messages that there shall be the minimum amount of troublesome interference. Of the various bills awaiting action, that of Representative Roberts, which has previously been considered in these columns, provides for a commission to recommend legislation after a careful investigation, and is the most conservative and appears on its face the least likely to work injustice to anybody. The bills which attempt in the present status of affairs directly to regulate the working wave lengths in use for wireless transmission are entirely too premature. In fact, before any attempt is made to enact legislation of this particular kind it would be very well for the Government officials who have to do with wireless, and the representatives of the various wireless companies, to go into informal conference to see what the various propositions really imply. It may turn out that in some of these propositions "jokers" are hidden, which would tend to throw burdens upon particular wireless companies either in the way of compelling a radical or inconvenient change of practice or by seriously affecting the patent situation. It would not be surprising if particular requirements as to accuracy of tuning and regularity of amplitude could be so drawn as to affect very seriously the rights of some people who are doing wireless business. While the patent situation in wireless communications is in its present tangled state, regulations of this particular kind are a bit hazardous, and if made would probably figure largely in the stock advertisements of some wireless companies.

It is certainly necessary that we should have regulation of wireless in order to check in so far as possible interference between commercial stations and to give them a fair chance to develop a paying business. This, we believe, can be done without working material hardship upon anyone and without restrictions of a burdensome character. The amateur wireless operator, too, needs to be taken in hand. It would be unfortunate indeed if legislation should take such a turn as to interfere with the legitimate wireless experimenter, either in the way of drastic regulation or of heavy license fees. Probably means could readily be found for limiting the disturbing effect produced by the experimenters, and without any question they should all be given Government registration and license so that in time of need Uncle Sam might put a restraining finger on any and every wireless plant that could possibly be used thoughtlessly or treasonably to the country's detriment. A thorough investigation of the working conditions of the art ought to give basis for sound and reasonable legislation on the topic, but it behooves various wireless companies to watch legislation carefully to detect any expressed or implied conditions which might not be equally fair to all the parties concerned.

CENTRAL-STATION ICE-MAKING.

Elsewhere in this issue is given an interesting account of the plant of the Holdrege Lighting Company, in Nebraska, where exhaust steam is being utilized for ice manufacture by the ammonia-absorption process. There is a long-standing controversy among ice-machine men as to the relative merits of the ammonia-absorption and compression processes of ice making. While it is charged that an ammonia-absorption plant usually costs more than the compression plant and also requires more cooling water for its operation, on the other hand, it is claimed that the operating expenses are considerably lower for an absorption plant operated in connection with an electric lighting plant than for a compression type of plant. At any rate, the plant at Holdredge is certainly making good, being operated at very little additional cost beyond that which would otherwise be required for the manufacture of electrical energy. One special feature of the Holdredge plant is the use of a large ice-storage house in connection with the ice-making plant. This is unusual, but, as shown in the article, is justified by the fact that the company has exhaust steam available for ice-making every day in the year, whereas the demand for ice is a peak-load demand limited to a few summer months. By storing ice during the winter season the tonnage of ice available per day during a short summer season is increased nearly 300 per cent. The refrigeration of this cold ice-storage plant would be too expensive were it operated independently of the electric plant, but with the electric plant operating continuously there is exhaust steam available the year around. The demand for artificial ice is steadily on the increase, just as is the demand for electric lamps and motors, so that ice-making as a by-product is up for serious consideration by an increasing number of stations.

THE MINNESOTA ELECTRIC LIGHT CONVENTION.

The Minnesota Electrical Association held an unusually successful convention at Minneapolis during the Electrical Show last week, as noted elsewhere in these columns. Although meeting in a modest and unostentatious way, it sometimes hap-

pens that these State central-station conventions bring out some facts of considerable future significance to the industry, and the convention last week at Minnesota was unusually prolific in this respect. Early in the program some of the members who were well acquainted with central-station earnings in various parts of the country were considerably startled to learn of a central station having earnings of $10 per capita from electric light and power service alone, in a city with an approximate population of 15,000. The same speaker, Mr. R. W. Clark, president-elect of the association, expressed the opinion that $20 per capita will not be considered as the saturation point of annual gross earnings for central-station service five years from now. While Mr. Clark's $20 estimate may be rather sanguine as to possibilities of the immediate future, the fact that he could testify positively to gross earnings of $10 per capita per year in a case with which he was familiar, was in itself surprising enough. It practically sets a new high-water mark for gross annual earnings per capita. It has heretofore been considered that about $8.50 represents the highest development yet obtained, although few progressive central-station men would dare to name any saturation point.

Another statement of considerable interest was made by Mr. Fred G. Dustin, in his paper on the grounding of secondaries. As is well known among central-station men who have investigated the matter, water-works officials are very much inclined to object to the grounding of secondary circuits on water pipes. At the same time it is fairly well established that the only form of ground of general application, which is reasonably reliable in some cities, is a ground on a water-pipe system. It is gratifying to learn that the city water department of Minneapolis not only allows such grounding, but that the chief engineer favors it, and does all he can to further the movement. It is really a movement in the interest of public safety. Any municipal water department should, therefore, readily give consent to the practice of grounding on water pipes. Nevertheless, there has been an indefinable fear in the minds of water-works officials, knowing nothing of electricity, that such ground connections might prove injurious. This has probably grown out of the old troubles with electrolysis from the grounded circuits of electric railway systems.

Another notable statement made at the convention was regarding future possibilities in incandescent lamps. In the course of a discussion on this subject, Mr. S. E. Doane, chief engineer of the largest lamp organization of the country, expressed the opinion that a lamp with a consumption of 0.5 watt per candle is easily within the range of possibility in the future, although he did not express any opinion as to how soon this might come. In this connection it was also stated that the tungsten filament is likely at any time to be made much stronger than it is now, and that filaments of considerable mechanical strength have accidentally been produced in the laboratory several times. In this connection we may recall the important announcement recently printed in these columns concerning the perfection of a method by one of the large American lamp manufacturers, whereby pure tungsten is obtained of high tensile strength and so ductile that it can be drawn into the finest wire. As regards the influence of high-efficiency lamps on the future of the central-station industry, it was apparent from the discussion at the convention that central-station men are in no fear of any future developments along this line. They are evidently convinced that the situation will automatically regulate itself in the future as it has in the past, and that increases in lamp efficiency will be followed by increased demand for light and by increasing use of electricity in other directions. As pointed out by one speaker, it would be a great boon to the industry should the total maximum peak demand for light be reduced, provided the same revenue could be obtained from consumers by electrical energy taken at other times of the day. Thus, the load factor of the station would be considerably increased and its earnings per kilowatt capacity, or per dollar invested, would be better than now.

THE CHARLOTTE A. I. E. E. CONVENTION.

Success even beyond expectation attended the meeting of the American Institute of Electrical Engineers held in Charlotte, N. C., last week, a report of which is printed elsewhere in this issue. In point of attendance, the registration considerably exceeded that of the general meeting of the Institute last year, while the interest exhibited was such as to assure everyone that the holding of local meetings can be made a most important means of enlarging the influence of the Institute and making it a truly national body. In the present case the Charlotte meeting proved so highly successful that it is to be regarded as a "Southern Convention" rather than merely as a local meeting. Not the least important factors contributing to the success of the convention were the limited number of the papers on the program and their practical character; moreover, while of general interest, the papers applied particularly to conditions and equipments existing in the locality where the convention was held. The interest both in a paper and in the equipment discussed therein is much augmented when one is afforded the opportunity to inspect the latter in detail during the convention at which the paper is presented. It was quite appropriate, therefore, to present at the Charlotte convention papers dealing with textile mills, gas engines, hydroelectric equipments and high-voltage transmission, and to arrange visits to corresponding plants in that community. Even the papers on electric furnaces possessed an element of local interest in drawing attention to the intermittent electrochemical processes which can be arranged to provide a valuable load for a hydroelectric plant during the non-peak hours.

In the discussion it was brought out that for the protection of a transmission line from disturbances due to lightning, the overhead grounded wire has proved highly effective. The chief objection to the grounded wire is the expense connected with its installation and maintenance. A less expensive substitute, previously noted in our columns and which has given good service in the protection of insulators on a Niagara line, was described in a paper by Mr. L. C. Nicholson. Use is made of a so-called arcing ring surrounding the lower part of the insulator and connected to earth by a direct path of low impedance. The ring protects the insulator by providing a path for the arc at a sufficient distance from the porcelain to eliminate the possibility of its being destroyed by the heat before the circuit is opened by the automatic breakers. In some respects the action of the ring is similar to that of the spark-relief gaps sometimes used in parallel with high-tension insulators. A spark-gap in parallel, however, represents merely a weak point to invite the discharge to itself rather than across or through the insulator, while an arcing ring can be so arranged as not to decrease the

"sparking voltage" of the system, the ring serving to distribute the electrostatic lines of force so as to prevent concentration at some undesirable point, the strength of the insulation thus not being decreased by its presence. That is to say, the ring may perform the double function of decreasing the liability to form an arc and minimizing the destructiveness of the arc when formed. In comparison with the overhead grounded wire, it is very much less advantageous in preventing disturbances, its chief value being in the protection of the insulator when disturbances do occur, and thus permitting the service to be resumed immediately after an interruption of minimum duration.

SELLING ENERGY FOR MOTORS.

A paper before the New England convention of the National Electric Light Association last week, read by Mr. Davenport, of the Narragansett Electric Lighting Company, dealt with a topic which is of vital interest to every central-station manager —the raising of the load factor by increasing motor service. It has been the experience of many power stations that to secure this kind of load is not so easy as it seems on the face. Everybody knows that electricity provides the cheapest form of energy for small units. If a man wants ⅛ hp, ¼ hp or ½ hp he never thinks in these days of anything except an electric motor, if it can readily be obtained. Business of this kind comes to the central station as a matter of course. It is well known to those who have investigated the matter that where electric motor service can be had at rates now common it is easily cheaper than the local generation of energy by small steam or gasoline engines, or even by rather large ones. The general public, however, does not fully realize this side of the situation because the nominal costs of energy produced by heat engines—that is, the apparent cost, which is mostly made up of fuel—is often reported at very low figures, whereas, if all the items of expense are charged up, the cost is greatly increased. It requires some argument to convince a man who is running a 50-hp engine that he is losing money by operating it when reasonably cheap electric service is to be had. On the other hand, this class of customer is exactly what the central station wants and needs to better its load factor, while the very small motor user who comes without effort does not in the aggregate represent an amount of power large enough to be of great benefit except in a few localities peculiarly given over to small manufacturing.

Mr. Davenport's paper is devoted chiefly to a description of the progressive and efficient sales methods adopted in securing the larger class of motor business. The fundamental thing about it has been the very complete engineering investigation which has been undertaken. If a prospective customer comes in sight, the central station spares neither time nor expense in making an exhaustive and conscientious study of the conditions under which he is operating, so that it is able to show him by experimental figures just what gain he could make by passing over to electric service. It is not a question of slap-dash estimate and a casual figuring of discounts, but a really thorough and complete study of the economic conditions, a study which includes all the features of operation. By following up this process the Narragansett company secured last year 3000 hp of this larger motor work, including the equipment of every new factory building in the territory. In addition, the company systematically exploits heating and other special appliances with the result of still further increasing the load outside the regular lighting business. It has been found there as well as elsewhere that the general motor load does not proportionately increase the peak, as it tends to diminish as darkness comes on, so that it is decreasing while the lighting peak is rising. The excellent effects of the progressive policy adopted are obvious and the same method should be followed more frequently elsewhere. A good many central-station managers have reason to be ashamed of the number of steam and gas engines running right under their noses, particularly since this motor load is an especially advantageous and easy one to carry.

TUNGSTEN LAMPS FOR STREET LIGHTING.

We note with interest that the tungsten lamp for street lighting is making considerable progress abroad as well as in this country. Recent reports from England indicate that considerable activity is there being displayed in the use of powerful tungsten units for replacing arcs and high-pressure gas. London in particular, which has for the last few years been a sort of experimental hot-bed for forcing new illuminants, has been going in for tungsten lamps in a very notable way. Of course, the tungsten lamp for street lighting is entirely familiar here, but most of the units employed have been comparatively small. Electric lighting by incandescent lamps is conducted in this country very largely on series circuits, and the common sizes of lamps employed have been of 40 cp and 60 cp. The largest units of this kind we have in mind at present are the 100-cp series lamps in use at Hartford. In this city also a few 200-cp multiple lamps have been used, but as a rule the largest multiple lamp employed on this side of the water is the 100-watt size of 80 cp. Recent advices from London show a still further development in the employment of groups of 100-cp units and single lights as high as 300-cp. In Victoria Street, London, an experiment is going on involving the use of flame arcs as compared with single 300-cp tungsten lamps and groups of three 100-cp similar lamps.

Large tungsten units are now being produced in this country quite freely and the result of the London experiment will be watched with keen interest. Obviously the flame arc will show the higher efficiency, but the tungsten units have the advantage in steadiness and can be placed at the same cost, nearer together than the arcs, so that they should be able to give good general illumination at moderate cost. When it comes, however, to lighting streets with a minimum intensity of not less than one-tenth of a foot.candle it is highly probable that the much higher efficiency of the flame arc will enable it to win out against even the most efficient incandescent lamps. Experience here tends to show that for really bright street lighting the modern arc still retains the advantage over even the newest incandescent lamps, while for a moderate minimum intensity in cases where high maxima are not important, as in lighting streets densely overhung with trees, the smaller units answer admirably. Even a 300-cp tungsten lamp giving a mean spherical candle-power of perhaps 250 looks very feeble beside a flaming arc of three or four times the luminous efficiency and double the consumption of energy. On the other hand, it seems reasonably certain that big tungsten incandescents can beat out the comon forms of enclosed arc very handily when equal cost is the criterion.

The chief question is the probable effective life of the large

incandescent units. Up to 100 cp or thereabouts it is pretty well known and reasonably satisfactory. General experience in this country with other types of filaments has shown the larger units to be somewhat at a disadvantage, and whether the tungsten filaments can be made to break away from this bad tradition and show up really well in the more powerful lamps is a question for practice to settle. It does not require many replacements of incandescent lamps at $2 or $3 apiece to cover the cost of electrodes, trimming and upkeep in a modern luminous arc of much greater illuminating power for the same energy. To make incandescents really attractive to the central station, the replacement cost must be pretty low or the effective life considerably longer than at present. It is a good sign of the times, however, to find the big tungsten lamps freely in service on the street, for even if it does not mean any considerable replacement of the better class of arcs, it certainly indicates a probability of much better lighting than has been customarily given by incandescent lamps. It would be very interesting to know the real increase in the illumination of city streets that has been brought about by developments of the last two years. In some cities the change has certainly been a very striking one, and practice is progressing rapidly toward this all along the line.

INSURANCE FOR CENTRAL-STATIONS.

At the recent convention of the New England Section of the National Electric Light Association an interesting paper was read by Mr. W. H. Blood, Jr., on the subject of "Insurance from the Engineer's Standpoint." Central stations as a rule make little effort at either self-insurance or mutual insurance. The risk of the former is a serious one, and the mutual scheme, which has been carried out very successfully in the textile industry, has not yet found a firm footing in central-station economies in spite of the praiseworthy efforts made at work along this line. Most central stations, therefore, have to depend on the ordinary insurance companies for carrying their risks, and it was Mr. Blood's strong opinion, backed up by convincing figures, that the rates paid for this service were at least twice as great as the character of the risks should properly necessitate. The central station of 15 or 20 years ago was undeniably a very bad risk indeed. Very commonly the dynamos were located in a room with a wooden floor, frequently pierced by belt holes, and the whole structure after a short time of service became sufficiently oil soaked to be most admirable material for quick and complete combustion. Switchboards were a perennial source of danger, frequently of wood, often with masses of wiring close to inflammable walls and all exposed to danger from short-circuits.

It is not to be wondered at that the underwriters looked askance at such risks and punished them by almost prohibitive rates—rates which frequently forced the insured into coinsurance to an extent that involved chances of very serious loss. Incidentally, the underwriters inaugurated many reforms by punitive rates planned to prevent some of the particularly bad practices which used to be in vogue. The situation at the present time, however, has changed radically for the better, but the rates have not changed with it. Most of the new stations are nominally of fireproof construction and in this case the real degree of security against fire is relatively far greater than in the case of other so-called fireproof structures, bitter experience with which having shown that very many buildings nominally fireproof contain enough combustible material to insure their being a practically complete loss if fire once gets under way. Electric light and power plants of recent construction present a far higher degree of security, the amount of wood being relatively very much less than in most buildings reputed to be fireproof, and the risk of fire in the small amount of combustible material left is really exceptionally small. From such admirable construction there are, of course, many variations and some few old time stations with their attendant dangers still survive; yet the conditions are such that the rates established a few years ago seem abnormally high for the average conditions of construction.

Mr. Blood computes that the premiums paid in the year 1907, which he takes as an example, were about three times the maximum annual loss recorded for any one year in this class of risks, after subtracting from the total premiums the 45 per cent usually reckoned as making up the full general expense and profit of the insurance company. If his figures are correct, they show that the central-station industry is not getting the benefit of the improvements in construction which it has introduced, and there is an exceedingly good opportunity for mutual insurance unless the ordinary companies make prompt and material reduction in their rates. If the figures given are not correct, it is certainly the duty of the insurance companies to come forward with an explanation. In some respects electric light and power plants are difficult subjects of insurance on account of unexpected, even if not very great, elements of risk. In some cases apparently fireproof plants have actually been burned out from the inflammation of considerable quantities of oil, and the possibility of very heavy short-circuits represents a cause for fire altogether out of proportion to anything else within the range of ordinary conditions. Material which could hardly be ignited by common casualties may start a conflagration when exposed to the tremendous heat of a short-circuit. In this sense there are some unusual risks in electric stations which have probably had a moral effect on the underwriters quite out of proportion to their visible importance. The statistics quoted by Mr. Blood seem to show, however, that in spite of such mischances the actual damages by fire are exceptionally small in central stations rather than exceptionally large.

It must be admitted, too, that some of the more serious elements of loss in central-station fires are not covered by any form of insurance provided by the underwriters. For example, a switchboard fire doing relatively small damage to the apparatus itself may put the plant out of business for a period involving much direct and more indirect loss, or a cableway crowded with cables may become involved in a short-circuit with similar disastrous effects. Losses of this kind are not covered by ordinary policies and must be assumed by the stations themselves. It seems to us that the National Electric Light Association could do an admirable work by tabulating the causes and damages from fires in central stations and ascertaining the actual amount of premiums paid by the industry to the fire underwriters. If these figures bear out the apparently well-founded view of Mr. Blood, there will certainly be occasion for reform in the rates, and in any event the data obtained regarding the peculiar sources of danger which must be guarded against by central-station managers would be well worth many times the cost of obtaining them.

An International Co-operative Investigation on Electrical Standards.

By Edward B. Rosa,
Secretary of the International Committee on Electrical Units and Standards.

The International Electrical Conference, which met in London in October, 1908, passed certain resolutions with regard to electrical units and standards, but left to an international committee, which was established at that time, the duty of completing the specifications for the concrete electrical standards and of deciding upon a new numerical value for the Weston "Normal" cell which could be adopted internationally.

As is well known, the value for the Clark standard cell (1.434 volts at 15 deg. C.), which was adopted by the Chicago Electrical Congress in 1893, was not accepted by Germany. After further experimental investigations, Germany adopted the value, 1.4328 volts at 15 deg. C. England, America, France and some other countries have followed the Chicago Congress, whereas other countries have followed Germany, and hence there have been two different values for the volt in use.

In course of time, the method of preparation of the Clark cell was improved so that the cell became more reliable, but at the same time its electromotive force was slightly altered. At the Bureau of Standards, an allowance was made for the change in the e.m.f. of the Clark cell, so as to preserve the unit of electromotive force unaltered. In England, however, the original numerical value was retained in spite of the fact that the new cells had slightly different values from the old. The result was that a discrepancy arose between the values in use in England and America. Hence, there were and still are three different volts in use in different countries. The Weston Normal cell, officially adopted at the London conference in place of the Clark cell, has the following values: In America, 1.0189 at 25 deg., equivalent to 1.019125 volts at 20 deg.; in Germany, 1.0186 volts at 20 deg.; in England, 1.0184 volts at 20 deg. Some of the other countries have the same value as America, others the same as Germany. England adopted the last named value only one year ago, and no other country, as far as known, has followed its example.

The London Conference of 1908 adopted the ohm as represented by the resistance of a specified column of mercury, and the ampere as represented by a certain mass of silver deposited in a silver voltameter, as the two independent fundamental electrical units, and declared that the value of the volt should be derived from these two. The electrochemical equivalent of silver adopted at London was 1.11800 milligrams of silver per second per ampere of current. It was known that different investigators had obtained different values for the electrochemical equivalent of silver, according to the kind of voltameter used and the methods of preparing the silver nitrate, so that the international committee found itself confronted with the problem of preparing specifications for the voltameter, when there was a great difference of opinion as to the proper procedure and as to the true value of the electrochemical equivalent of silver, which had, however, been definitely fixed by the conference.

The International Committee on Electrical Units and Standards is authorized by the London Conference to complete the work of the Conference and to carry on intercomparisons of standards among different countries, and to promote investigations upon the subject of electrical units and standards, to the end of securing international uniformity with the highest obtainable accuracy. This committee represents 11 different countries, there being two members each from America, England, France and Germany, and one member each from Austria, Italy, Russia, Switzerland, Holland, Belgium and Japan. The president of the committee is Prof. Dr. E. Warburg, president of the Reichsanstalt, Berlin; vice-president, Dr. R. T. Glazebrook, director of the National Physical Laboratory, London; treasurer, Prof. S. W. Stratton, director of the Bureau of Standards; secretary, Prof. E. B. Rosa, physicist of the Bureau of Standards. The other 11 members of the committee are as follows:

Dr. Osuke Asano, Dept. of Communications, Tokyo, Japan.
M. René Benoît, Bureau International, Sèvres, France.
Dr. N. Egeroff, director, General Chamber of Weights and Measures, St. Petersburg, Russia.
Prof. Éric Gérard, Liège, Belgium.
Prof. H. Haga, Groningen, Holland.
Dr. Ludwig Kusminsky, Commission of Weights and Measures, Vienna, Austria.
Dr. Stephen Lindeck, Physikalisch-Technische Reichsanstalt, Berlin, Germany.
Prof. Gabriel Lippmann, The Sorbonne, Paris.
Prof. Antonio Ròiti, Florence, Italy.
Mr. A. P. Trotter, Electrical Standards Laboratory, Whitehall, London.
Prof. H. F. Weber, Zürich, Switzerland.

In addition to the 15 members appointed by the International Electrical Conference, the committee was authorized to elect associate members to assist in carrying on its work, and at its first meeting in London, following the Conference, five associate members were elected as follows: Dr. W. Jaeger, of Berlin; Mr. F. E. Smith, of London; Prof. Paul Janet, of Paris; Prof. H. S. Carhart, of Ann Arbor, Mich.; and Dr. F. A. Wolff, of the Bureau of Standards, Washington.

It was impossible to select a new value of the Weston Normal cell in terms of the ohm and the ampere until the latter should be more precisely defined than had been done by the London Conference. Correspondence among the members of the committee who were connected with national standardizing institutions seemed to indicate that it would be impossible to agree upon the specifications of the silver voltameter without further investigation, and it was proposed by the American members of the committee that a joint investigation to clear up, as far as possible, outstanding problems on the standard cell and the silver voltammeter be arranged with representatives of several of the national standardizing laboratories as participants. Prof. S. W. Stratton, in his capacity as director of the Bureau of Standards, offered the facilities of the Bureau of Standards for an international investigation, and in his capacity as treasurer of the International Committee on Electrical Units and Standards, offered to secure the funds to pay the expenses of the investigation. In this connection he received valuable assistance from Mr. John W. Lieb, Jr., who placed the matter before the governing bodies of the American Institute of Electrical Engineers, the National Electric Light Association, the Association of Edison Illuminating Companies, and the Illuminating Engineering Society. These four societies made appropriations of $500 each to defray the expenses of the proposed investigation. Their generosity in this matter is very highly appreciated by the International Committee on Electrical Units and Standards. Some smaller contributions were also received.

It was arranged that the proposed investigation should be carried out at the Bureau of Standards by representatives of the Bureau of Standards, together with one delegate from the Physikalisch-Technische Reichsanstalt, Berlin, one from the National Physical Laboratory, London, and one from the Laboratoire Central d'Électricité, Paris. These delegates, as appointed by the directors of the several institutions, are Prof. Dr. W. Jaeger, Mr. F. E. Smith and Prof. F. Laporte. These gentlemen have had a very considerable experience in work with standard cells and silver voltameters, have published various investigations on the same, and are eminently qualified to represent their respective institutions and to join in the work of research and deliberation upon the various questions that will arise during their stay in Washington. The representatives of the Bureau of Standards are Prof. E. B. Rosa and Dr. F. A. Wolff. In addition to published papers, a great deal of experimental work has been done at the Bureau of Standards and not yet published, which throws considerable light upon the questions at issue.

In addition to the work on standard cells and the silver voltameter, a comparison is to be made of the resistance standards of the several national standardizing institutions. The wire standards of the Reichsanstalt, the National Physical Laboratory and the Bureau of Standards differed only about

two parts in a hundred thousand at the last intercomparison about a year ago, the standards of the first two of the above institutions having been fixed independently by legally specified mercury ohms. It is expected that a common value of the international ohm will be agreed upon, so that no difference greater than one part in a hundred thousand will exist between the wire standards of the national standardizing institutions.

It is confidently expected that the committee will succeed in coming to a satisfactory agreement with respect to the official specifications of the silver voltameter and the Weston Normal cell, and will be able to agree upon a value for the latter which can be recommended to all countries of the world for adoption. The degree of accuracy which is now obtainable in electrical measurements, both in absolute measurements and in relative measurements, far surpassed what was possible in 1893, and indeed has increased greatly within the last five years. There is reason to believe that values adopted now will be satisfactory for a generation at least without change. The European delegates have brought with them, from their own laboratories, a quantity of apparatus and chemicals in order that they may reproduce work done in their own laboratories at the Bureau of Standards, as accurately as possible. Standard cells will be set up by the representatives of each of the four institutions and accurately compared and tested. In the same way different forms of silver voltameters will be operated in series with one another, and the quantity of silver deposited in each determined with very great accuracy. The Bureau of Standards has provided every facility for carrying on this work expeditiously and with the highest precision.

The three European delegates arrived from Europe recently and proceeded to Washington after a short stay in New York in order to begin their work at the appointed time, April 1. It is not known how long the work will continue, but it is hoped to complete it in two months.

Ohio Public Utility Bill.

After adopting a number of amendments of comparatively little importance, the Ohio House of Representatives has passed the Woods public utilities bill, outlined in these columns last week. As it now stands the salaries of the members of the commission will be $5,000 a year instead of $6,500, and the yearly expenditures of the body will be limited to $100,000. An amendment provides that gas and electric companies at the readjustment period under a continuing franchise contract, when the commission becomes a board of arbitration, may select to operate under either the old or new rate pending litigation, but that a bond must be given in case the high rate is selected for refund if the decision is adverse.

Another amendment provides that contracts entered into under present franchises shall not be affected and still another makes it possible to file schedules of rates with the commission by August 1, instead of thirty days after the passage of the bill. An attempt to amend the bill in such a way as to give the commission a veto in the case of new franchises, failed of adoption, and the fight made to remove the clause providing for a restriction of stock of other companies that may be held by a utility company to 25 per cent of the total issue, was lost. This restriction, it is claimed, will prevent gambling in utility stocks, and also prevent the operation of holding companies, although this was not in itself considered an evil, with the supervision of the commission over them. A company may hold any amount of stock of another company as security for a loan.

Maryland Public Utilities Bill.

The Maryland Public Utilities Bill passed the House of Delegates at Annapolis last week by a vote of 95 to 3. Out of the four measures that were considered in the committee room, the Straus bill was the only one that was favorably reported upon. Strong opposition to a vote on the bill developed when it came before the House, but finally the opponents of the bill were forced into line and the measure was almost unanimously carried. The amendments, of which there are nearly 40, were added with the drafter's consent and are stated not to modify essentially the workings of the original measure. Many other amendments were offered at the last moment, but were all killed after much bitter fighting. Attorney-General Straus, the author of the bill, said that the fight for the measure was one of the finest parliamentary battles that he had ever seen.

Serious opposition to the bill is expected in the Senate. Both the Governor and the Attorney-General were at the State House last week working in its interest. While the Governor was busily occupied lobbying along his own lines, Mr. Straus lost not a minute in button-holing Senators and pleading for the bill. Many of the Senators are opposed to spending $75,000 for a public utility commission, and it is believed that Mr. Gorman, the president of the Senate, wishes to have the amount reduced to $15,000, and this seems to be the sentiment of a great number of his colleagues.

In spite of the serious danger in which the bill is now, there are several names being mentioned for places on the commission, and among them is one of the most prominent Democratic members of the present Legislature and a strong party man. It is thought that a Republican may also be one of the commissioners in view of the fact that it may become necessary to make such a stipulation before the measure will be passed by the Senate. The bill is now in the hands of the Senate Committee on Finance and it has not yet been reported. It is said that there is a division of opinion in this committee and that on several occasions the vote has been 4 to 4. The Attorney General has requested that there be no changes made, fearing that it may have to be returned to the House and killed through this means.

By a vote of 58 to 24 a bill granting the Baltimore Light & Power Company, which is the old Baltimore Refrigerating & Heating Company, the right to take over the Fentress and Mediary franchise to manufacture and distribute electric energy in the city of Baltimore, was killed in the Maryland House of Delegates last week. If the Legislature would have given this company the right to take over this franchise, the company would not have been compelled to go either to the Mayor or to the Board of Estimates for the right to distribute electric energy in Baltimore, but would have had the right to begin operations immediately. There is another bill now pending which provides that all new companies must have the permission of the Board of Estimates before beginning operations.

A new electric bill has been introduced to replace another which stipulated that no company could be empowered to sell energy in the city of Baltimore unless it had a paid-up capital of $1,000,000. The provisions of the new bill are that any responsible concern having electricity is authorized to sell it for lamps or motors, with the consent of the Board of Estimates. Individuals and firms are authorized to sell surplus energy to their neighbors, provided that the Board of Estimates grants them the right. The clause in the original bill requiring a corporation to have a capital of $1,000,000 is eliminated. In other woods, the electric bill is open to all so far as the City of Baltimore is concerned.

Reissued Patent Invalid Because of Broadened Claims.

The U. S. Supreme Court has refused to grant a writ of certiorari to review a decision rendered by a U. S. Circuit Court of Appeals declaring invalid a reissue of a patent granted July 19, 1904, to William B. Potter for improvements in the control of electric motors. The original patent was issued Aug. 14, 1894, and relates to a combination in an electric controller, of a switch having a multiplicity of contacts, and a blow-out magnet having a common pole piece extending from a common core to points adjacent to the several circuit-breaking points of the switch. The reissue in suit was invoked on the grounds that the original patent did not describe with sufficient definiteness and accuracy the action of the magnetic arc extinguishing device involved, and that the term "arc deflector," as used in the specifications, was uncertain and ambiguous.

In a suit instituted under this patent against the Richmond

Street & Interurban Railway Company the defense was made that the reissue was invalid on the ground that it gave a broader scope to the invention than the original patent. In its opinion the Circuit Court of Appeals stated that the Commissioner of Patents is not authorized to grant a reissue unless either the original specification is defective or insufficient, or the original claims embrace more than the patentee had a right to claim as new; furthermore, that neither of these conditions is available unless the error arose through inadvertence, accident or mistake, and without any fraudulent or deceptive intention.

The Circuit Court held that the original specification neither contained erroneous statements or facts, nor failed to give a description in such full and clear terms as would enable any person skilled in the art to construct and use the device; and that if the appellant had sought a reissue merely to remove any alleged doubt concerning the sufficiency and accuracy of the explanation of the action of the arc-extinguishing mechanism the controversy in suit would probably never have arisen, as this actually centers on a comparison of the original and the reissue claims. After a presentation and discussion of the original and reissue claims, the court decided that the application to recast the claims was made, not for the purpose of narrowing the original patent because the patentee had claimed too much, but for the purpose of allowing a wider monopoly than could have been built up under the original patent, which attempt, it states, must be held to be futile. In conclusion, the court decided that as there exists none of the conditions precedent to the right of the Commissioner of Patents to grant a reissue, the grant is utterly void. The parties to the litigation were the General Electric Company and the Allis-Chalmers Company.

Store Lighting.

The lighting of a carpet and rug store was discussed at the March meeting of the New England Section of the Illuminating Engineering Society, which was held at the Edison Building, Boston, with the chairman, Mr. T. H. Piser, presiding. Two papers were presented, the first being by Mr. Benjamin T. Bean, who discussed the solution of the store illumination by gas methods, and the second by Mr. L. Brent Foster, who took up the problem from the electrical point of view. The store was 102 ft. long, 26 ft. wide and 14 ft. 3 in. high, with shelving on both sides, reducing the width for the most part to 21 ft. The gas lighting solution specified the use of five-mantle gas arcs hung 12 ft. above the floor, the average intensity being 4.03 ft.-candles. The intensity of the wall lighting varied from 3 ft.-candles to 4.1 ft.-candles. Twenty-seven lamps would be installed, allowing 10 for the rear section of the store. Alabaster shades were specified.

Mr. Foster took up the electric lighting of the store on the basis of an illumination of 4.2 ft.-candles. A very high and strong light is needed. The quality of light is as important as the intensity, for the reason that a carpet store must be provided with a quality of light which will bring out fairly the illumination of daylight. The satin-finish reflector was specified. The carpet-room portion covers a space 84 ft. long and 21 ft. wide, or 1764 sq. ft. The room was divided into squares of 10.5 ft. each, and 17 100-watt tungsten lamps provided. The shelving is 7 ft. 5 in. high, packed up on the top with carpeting. The reflectors were to be placed 9 ft. above the floor or plane of illumination, because a strong light is needed on the floor in such a store. If the room had been 10 ft. wider it would be necessary to use 150-watt lamps.

In the discussion which followed the disadvantages of too many outlets from the point of view of the purchaser were considered. The opinion was advanced that the day has passed when the customer considers his gas or electric bill alone. When the tungsten lamp first came out it was sold by men who dwelt upon the merits of its energy consumption. That condition does not exist now. The man of to-day is not trying to cut down his current bill, but is taking three times the illumination that he had before, and is in general very much pleased with the situation. The lighting companies have found this to be true, and this is the reason why they have pushed the tungsten lamp. Exceptions exist, but this is the general trend. If a good-sized dealer fits out his store so that it is lighted from 20 per cent to 50 per cent better than his neighbor's, the latter will soon get into line.

The case was cited of a merchant who complained about his bill, because he was not getting results even though the expenditure was high. The bills were $75 to $80 per month. The installation contained a basement and a backroom which had not been lighted before, but tungsten lamps were put in, and the bill was cut down to $40 or $50 per month. This made the merchant feel that he could afford to light his basement and backroom, bringing an additional revenue to the company of $20 per month. An electric sign was then put in, and to-day the bill is $110 per month, and the customer is entirely satisfied with the results. The difficulty of getting operators in factories to accept bowl-type reflectors in place of flat shades and bare lamps was touched upon. The operator looks at the light and not as much at the surface illuminated. In one rug store carbon lamps were used successfully on the cheaper grades of rugs to make them appear warmer in tone. Tungstens were used on the more expensive grades.

The Electrical Show at Minneapolis.

The first Electrical Show held at Minneapolis was opened at the Armory on Kenwood Boulevard from March 26 to April 2, 1910. This show was held under the management of the Northwestern Electric Show Association, this association consisting of the prominent electrical men in Minneapolis.

The management of the show was in charge of Mr. Geo. J. Cadwell. Other prominent officers of electrical companies and supply men who form the official directory of the association were as follows: President, Mr. Fred G. Dustin; vice-president and general manager, Mr. Geo. J. Cadwell; secretary, Mr. C. D. Wilkinson; treasurer, Mr. A. W. Leonard. The directors consisted of the officers and Messrs. W. E. McDonald, J. L. Barnard and W. S. Smith.

A general view of the Armory taken during the Electrical Show is given herewith. A uniform plan of booth and decorations was used, the scheme being similar to that of the Chicago Electrical Show. Imitation art glass globes and domes were used for decorative lighting each booth. The upper part of the building was draped in light colors with tinsel ornaments which reflected the colored light thrown upon them. Four searchlamps, one in each corner of the building, cast beams of colored light on the central area of the ceiling, presenting a very pleasing effect. A dirigible balloon, which was to be controlled by wireless telegraph, was anchored in the center of the Armory during the first days of the show, but was exploded by accident Monday forenoon. By great fortune, the explosion did not start a big fire, and occurred at a time when but few people were in the building. Otherwise a serious panic might have resulted. John T. Rossiter's band gave concerts afternoon and evenings assisted by Blanche Berndt Mihaffey, soprano soloist. Prof. M. M. Wood, of Chicago, gave four of his very interesting lectures and demonstrations on the gyroscope and monorail car each day. The peculiar actions of this piece of apparatus never failed to excite wonder.

The Minneapolis General Electric Company, which gives central-station service in Minneapolis, occupied a set of compartments or rooms across half of one end of the building. These rooms were fitted up as rooms of a model electrical house, including kitchen, dining-room, living-room and bedroom. Each room had an electrical equipment up to date, in accordance with similar equipments which have been shown at other shows, and with which central-station men are familiar. The company used the Electric Show as the means of first introducing to the public of Minneapolis its special $10 offer for the wiring of houses. These $10 wiring certificates, which were issued by the company during the show, read as follows:

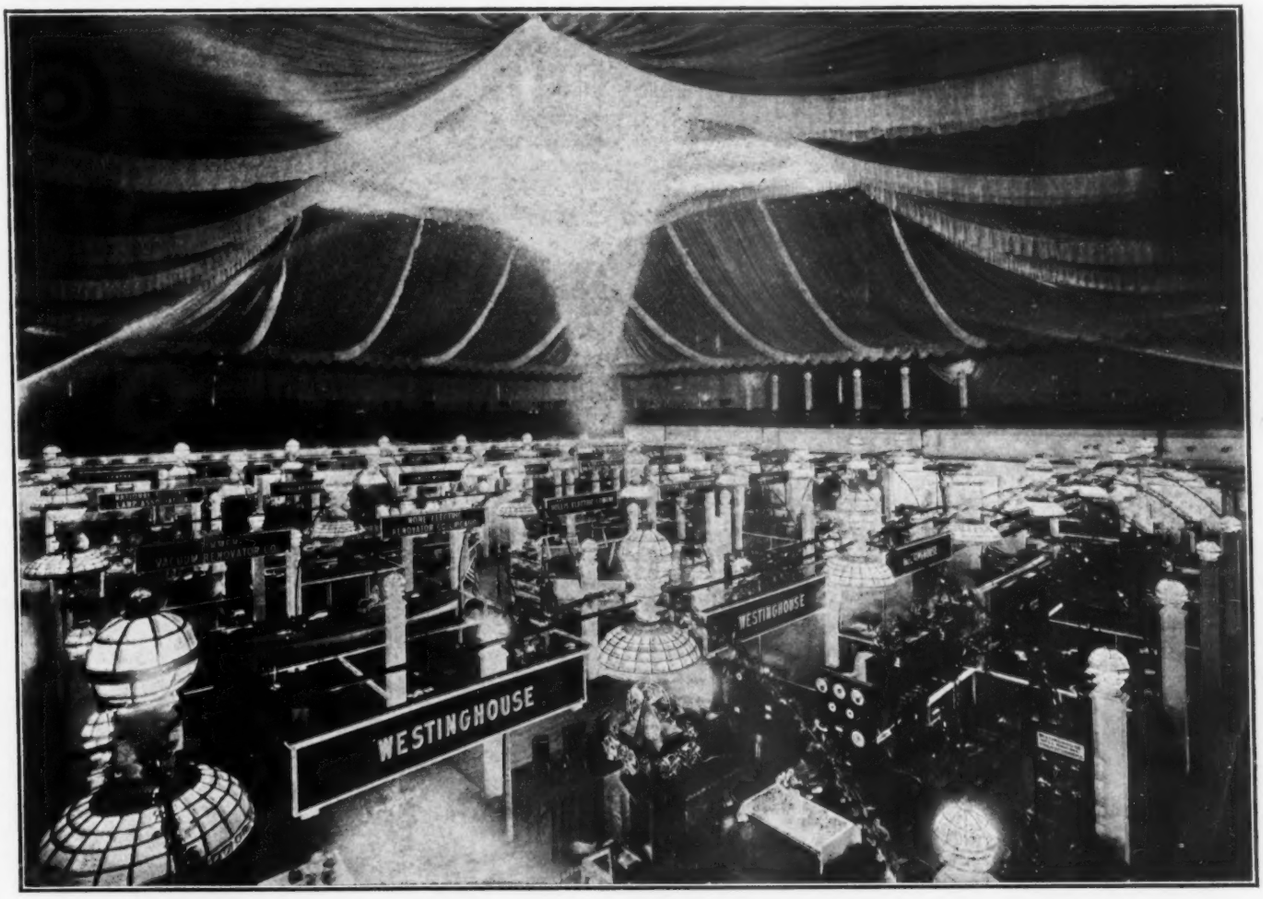
"WE WILL PAY $10.

"For the next three months, we will pay, subject to terms and

conditions on reverse side, $10 on the cost of wiring any existing residence for electric light, located on our present lines, and we will furnish free first installation of standard lamps. This certificate is void unless registered at our model electric home exhibited at the Electrical Show, Armory, March 26 to April 2.—The Minneapolis General Electric Company." The terms and conditions of this $10 free wiring offer as given on the back of the certificate are as follows:

1. This offer applies only to residences on our existing lines where no extension of service is necessary. 2. At least three competitive bids must be secured on the cost of a complete installation of wires. Copy of bids must be furnished the Minneapolis General Electric Company. 3. The above allowance—$10—will be allowed on lowest bid and paid to contractor upon final city inspection of wires and signing of application for service for applicant. 4. This offer applies only to residences not previously wired and expires on July 1, 1910.

The attendance at the show during evenings was as large as the main floor of the Armory could comfortably accommodate. Had the attendance been larger, it would have interfered considerably with the real examination of exhibits. Fifty-six manufacturers made exhibits, and although the show could not compare in size with those of New York and Chicago, it made a neat little exhibition equal in quality, if not in quantity, to any of the larger shows.



General View of Electrical Show at Minneapolis.

Prof. Geo. D. Shepardson, of the University of Minnesota, loaned a very interesting historical exhibit, showing some early types of electrical apparatus, and the evolution of the incandescent lamp. Among the features of this exhibit which attracted special attention was the first alternator built in Minnesota, which was the work of Mr. H. J. Gille, now contract agent of the Minneapolis General Electric Company. This little machine had bolts for field magnet cores and a piece of pipe coupling for a field ring.

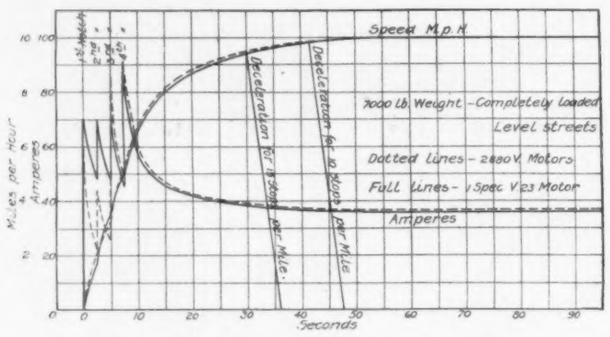
The Electric Vehicle.

The annual meeting of the Electric Vehicle and Central Station Association was held at the Edison Building, Boston, Mass., on the evening of March 30, with President Frank J. Stone in the chair. Mr. Stone opened the meeting with congratulatory remarks upon the results of the first year's work of the association, which has awakened a strong interest in the electric vehicle and has fostered the triple alliance between the central station, the manufacturer and the public. The following officers were then elected for the ensuing year: President, Mr. W. H. Blood, Jr., of Stone & Webster, Boston; treasurer, Mr. L. R. Wallis, Edison Electric Illuminating Company, Boston; secretary, Mr. F. W. Kimball, Malden Electric Company. The executive committee elected consists of Messrs. N. T. Wilcox, O. F. Brastow, S. G. Thompson, A. F. Neale, E. J. Baugher, T. K. P. Stilwell, F. J. Stone, Day Baker and E. W. M. Bailey.

A paper by Mr. C. E. Michel, Union Electric Light & Power Company, St. Louis, was then read upon "The History of the Electric Vehicle Business in St. Louis." The author described the rapid development of the electric automobile in the territory through the creation of a separate department for such service by the central-station organization, the establishment of a large garage in the residential section, costing about $50,000, the pushing of an advertising and educational campaign and the organization of an efficient selling force. To-day there are 350 electric machines in the city compared with 17 three years ago. There are eight public garages, four of which deal with electric vehicles only, and an electric truck garage. About 60 rectifiers are in service. The pleasure car has distanced the commercial wagon in St. Louis. The department has now become more than self-supporting, although from the first the garage of the central station was charged with all expenses of exploitation. Forty-six rectifiers averaged an income to the company

of $11.33 per month each, and one garage has paid $2,352 in six months for energy alone. Ninety per cent of the load is of the off-peak variety. The company takes an equal interest in all makes of cars. The paper concluded with a brief description of the company's garage and record system.

Mr. William P. Kennedy, chief engineer of the Studebaker Brothers Company, New York, then read a paper on "Sensible Electric Vehicle Campaign Methods," making a strong plea for the maintenance of an impartial attitude regarding different makes of cars by the central-station companies. The problem is to convey to the prospective users a spirit of confidence in the stability of the electric vehicle, which can now legitimately be done after over 12 years' successful application and service. Contention over details of design is bound to be regarded as evidence of instability in the art and is certain to force customers into a sceptical attitude. The electric vehicle can in most cases make a driver twice as useful as he formerly was, without imposing additional burdens upon him; and the wages of a single driver saved will usually cover the cost of maintenance and upkeep of a machine employed for light goods delivery. The principal parts of electric wagons are the product of well-developed manufacturing organizations, and consequently the purchaser is not making investment in novelties or experiments. The user need not change the class of help employed, since the machines are pretty nearly foolproof, with the least possible amount of moving mechanism in such apparatus. The electric vehicle user has the most skilled advice at his elbow. Such points carry weight with most sound business men who are ready to invest their money for the reduction of expenses or improvement of service. If the central station becomes an agent, neutrality should be its general policy between different makes of machines. The central station cannot permanently remain in agency relations with any particular manufacturer as a



Speed-Time Curves of Two Electric Vehicles.

matter of necessity to the preservation of its own ultimate interests in the situation. The maintenance of public garages is more consistently the field for the central station. Perpetual revenue from every machine in service should be the watchword of central-station policy. The paper concluded with a vigorous argument in favor of keeping clear from technical points of difference in the marketing of vehicles by central stations, and the observation of a liberal neutrality between reliable makers.

A paper was then read on "Two Versus One Motor Equipment for Electric Vehicles," the author being Mr. J. D. Forrer, of the Westinghouse Electric & Manufacturing Company, Pittsburgh. The paper discussed the technical aspects of vehicle motive power, concluding that a two-motor equipment is preferable for this service, although the differences are not as marked in performance as is frequently supposed. For pleasure vehicles of moderate size the single-motor is unquestionably advantageous. The principal arguments in favor of the single-motor equipment for general service are: higher motor efficiency, smaller weight, lower first cost, simpler control, and lower maintenance costs. The difference in efficiency between two ¾-hp and one 1½-hp motors is about 5 per cent or 6 per cent, while the difference between two 2-hp and one 4-hp motors is not over 2½ per cent Efficiency becomes less important as the size of the motor increases. Similar considerations apply to motor weights. The equalizing gear used by single-motor equipments offsets the slight reduction in weight over two motors of the same total capacity. The maintenance of two motors and a controller is less than that of one motor, its controller, equalizing gear and external resistance.

An analysis was made of the performance of two vehicles equipped with a single and two motors, respectively, each being laid out for a speed of 10 miles per hour on the level, and equipped with 40 cells of battery. The two-motor vehicle was equipped with two 20-amp, 80-volt motors and weighed 6950 lb. loaded. The single-motor truck was equipped with one 40-amp motor and weighed complete 6720 lb. Rolling friction was assumed at 16 lb. per 1000 lb. weight of vehicle for each equipment. Four-speed controllers were used for each. The two-motor outfit takes advantage of the series-parallel combination, while external resistance is required on the first two notches with the single equipment. The accompanying figure shows the speed-time curves of the two outfits, the controllers being held on each notch for 2½ seconds. The speed of feeding the controller imparts to each vehicle an average acceleration of 0.67 mile per hour per second. The diagram shows little difference in the performance, except a somewhat reduced energy consumption with the two-motor outfit. The single motor has a slightly greater mileage on the third and fourth speeds, but the two-motor outfit makes the greater mileage on the first and second speeds. The following table shows the mileage which each vehicle can be expected to make on the fourth notch:

Stops per mile.	Single motor.	Double motor.
15	26.9	28.9
10	30.8	32.6
3	41	41

These figures show a better mileage for the two-motor equipment on service having more than three stops per mile, while with less than three stops the advantage is slightly with the single motor, increasing until with continuous operation without any stops the mileage is 47.8 on the single-motor and 46.3 on the double equipment. The external resistance cannot be adjusted to give smooth acceleration on both level and grade start. Whenever a vehicle equipped with one motor deviates from a straight line the friction losses of the equalizing gear are added to those of the single-motor equipment. The same deviation does not affect the losses of a two-motor outfit. The author pointed out that there is no method of determining this loss in the equilizing gear, but it is clear that it will reduce the mileage. There are four economical speeds on the two-motor controller and only two on the single equipment. The author contended that the two-motor equipment can operate economically at 3.3 miles per hour, while the single-motor outfit cannot operate economically at less than 7.2 miles per hour. Shunting the fields of the single-motor equipment while in series or in series parallel is not economical. Neither does series paralleling the batteries give good results on account of the danger of getting unequal discharge of the two halves of the battery. The second driving wheel has practically no torque upon it when one driving wheel slips in the single-motor equipment. When one driven wheel of a two-motor equipment slips, the other wheel still has the full torque of one motor.

Proportioning of Electrodes for Electric Furnaces.

A paper on furnace electrode design was presented at the recent Charlotte A. I. E. E. meeting by Mr. Carl Hering, containing the results of an investigation by the author of the question of the proper proportioning of electrodes and the losses in them. Believing that no one had made a thorough investigation of this subject, based on unquestioned fundamental laws, the author some time ago made a careful study of the true underlying principles based on indisputable physical laws. The results of this work showed that some of the former rules used for the designing of electrodes were positively wrong, others were entirely inadequate, and still others were very misleading.

The investigation was made both analytically and experimentally, and the present paper gives the results of both.

The fundamental principle on which the whole analysis is based is that there shall be no flow of heat through the hot end of the electrode—that is, there shall be no loss of heat from the furnace to the electrode, hence no chilling and no high temperature point within the walls. The electrodes are, therefore, so proportioned that the current through them will heat the hot end just to the furnace temperature.

The analysis shows that under the simplying conditions of uniform conductivities from end to end, this condition is also that of minimum total loss. It also shows that it is not proper to add the heat conduction loss to the resistance loss in order to get the total, as was formerly the general practice; the proper way is to add the former to only half the latter. It also shows that current density is not a determining factor in the design of electrodes; also that the resistance is not a matter of choice, but is determined by the conditions; also that the conditions determine either the length or the section, but not both, hence leaving a choice; it is only the ratio of the section to the length which is the determined factor; also that neither the electrical resistivity nor the thermal conductivity alone are governing factors; it is their quotient and product which are the true measures of the qualities and electrodes. The quotient of the thermal over the electrical conductivity is shown to determine the loss, while the product of the two resistivities determines the proportions, hence it is not necessary to know either one or the other of these properties, but only their quotient and product; it is, furthermore, shown that these are are more easily determined than the others. These two quantities lead to some new quantities not heretofore used, and by means of which the calculations of electrodes become extremely simple.

These two new quantities are the loss factor and the size factor. The values of there are tabulated in the paper for each of various temperature ranges, so that the only calculation left to be performed is a simple multiplication. One of these is the loss factor called "watts per ampere"; this is multiplied by the current and the result gives the loss in watts directly, under the conditions stated above. The other new quantity, called the "section per ampere per inch of length," is similarly tabulated for various temperature ranges and is such that when multiplied by the current and by the length it gives the cross-section directly in square inches.

This is one of the main features in the paper and is the final result of the investigation. Tables of these factors are given, besides a long table of other properties of the electrode materials, carbon, graphite, iron and copper, besides a large number of curves in which these values are plotted from the experimental determinations. These plotted values include practically all the different quantities which enter into the problem, and they are believed to be the first set of such values that have ever been determined.

They were determined by the method suggested by the author, in which method rods of the different materials are practically operated as furnace electrodes under the desired condition of no heat flow at the hot end, and the constants are then measured; from these measurements all the others are deduced. Many interesting and useful facts are brought out by the constants, as given by the author in his paper, a number of which had not been known before.

In the analysis the author has followed the process recommended by able scientists in considering the problem first under its simplest conditions, leaving minor correction factors to be considered later, if it is found necessary to do so.

In the author's method described in the paper, however, most of these minor correction factors are taken care of by making the determination of the constants in such a way that these factors are included in the results. Hence, the final results eliminate most of these correction factors by inclusion in the constants.

In this analysis he determines what he calls the laws of electrode losses, the more important of which have already been given above. He shows that these laws are fundamental and absolute under the assumed premises, namely, under the simplified conditions.

Among other things he shows that flow of heat in such electrical apparatus is best measured and expressed in watts, as this greatly simplifies the numerical calculations.

Formulas are given, all of which are extremely simple, showing the relations between all the various quantities.

The experimental constants obtained are the proper mean values under electrode conditions to be used in these formulas and when so used they include the correction factors due to temperature variations of the two conductivities. These mean values are peculiar to electrodes, as they are neither the arithmetic nor the geometric mean, and he, therefore, terms them the "electrode mean."

The author has ventured to extend somewhat the curves drawn through the experimentally determined points so as to give approximate values for temperatures beyond those at which the tests were made, but he calls attention to the fact that they are only exterpolated values and should be used only as approximate and probable values until they have been definitely established experimentally.

These curves bring out a number of features which apparently have not been known before, and enable interesting and useful deductions to be made. Among other things they show that at moderate temperatures the mean thermal conductivity of carbon under electrode conditions rises instead of falling, as heretofore claimed, and is very much higher than was formerly supposed, being numerically equal to between one-half and one-third that of graphite instead of being one-eighth, one-tenth and even one-eighteenth as was formerly claimed; also that the mean thermal conductivity of graphite is even greater than that of iron.

All the formulas and tables are given in actual units so that they can be used directly in practice. The investigation was made from the standpoint of the requirements of the engineer as distinguished from those of the physicist or academician. By thus neglecting the minor factors, which are too small to be of any importance to the engineer, the results become greatly simplified and are in such form that they are easily applied in practice.

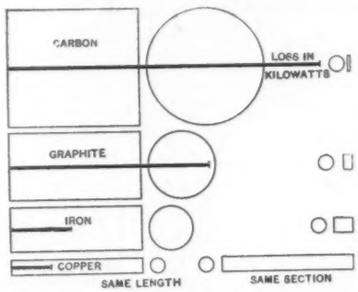


Diagram Showing Comparison of Sizes and Losses.

As an example of the general results one of the illustrations is reproduced herewith, which shows the relative sizes and losses of electrodes made of different materials for a furnace requiring 10,000 amp and having a furnace temperature of 1400 deg. C. The first set shows the different cross-sections for the same length, and the second set the different lengths for the same cross-section; the heavy lines represent by their length the total losses in the different electrodes. This shows that carbon electrodes tend to become very large in cross-section, often impracticably so, and that even with these much larger proportions the minimum loss is still considerably greater than for graphite, and that both of them are very much greater than for iron.

At the close of the paper the author summarizes the final results as far as they pertain to the design of electrodes, and in conclusion gives a summary of the previous discussion of his method by others.

Convention of the Minnesota Electrical Association

The third annual convention of the Minnesota Electrical Association was held in Minneapolis March 29, 30 and 31, 1910. The sessions were in the Armory on Kenwood Boulevard, in which building the Electrical Show was being held. The prosperous condition of the association and the fact that the Electrical Show was in progress served to bring out a large attendance of central-station company and municipal plant managers. This association is notable for the considerable number of managers of municipal plants which take an active part in its affairs.

The first session was called to order Tuesday morning, March 29, by President H. J. Gille, of Minneapolis. He announced that the entertainment features of the convention would consist of a special lecture by Prof. M. M. Wood on the gyroscope Tuesday evening and a dinner tendered by the manufacturers and supply dealers at the Kaiserhof, Wednesday evening. The membership committee reported seven new central-station members.

President Gille then delivered his address, which touched upon a number of matters of considerable importance to the central-station industry. He said that the past year had been one of great prosperity, especially in Minnesota, and the benefits of this prosperity have been felt by the electrical industry. Probably no other necessity had decreased in cost in recent years like electric service. This is due to more efficient apparatus, economy of operation, and the better load factor conditions due to a more general use of electric service and higher efficiency of energy-consuming devices. Through these changes he anticipated in the near future the almost universal adoption of electric lighting service. Brilliant lighting of a store has come to be recognized as an important element to success in business. A well-arranged show window is recognized as one of the best means of advertising and its efficiency is greatly increased by the proper use of light. A show window is more attractive by night than by day if well lighted. The advent of the tungsten sign lamp has made a greater change in the efficiency of sign lighting than in any other class of illumination, because the old carbon-filament sign lamps were so inefficient. Electrical advertising has, therefore, been greatly reduced in cost and occupies a prominent position.

Mr. Gille referred to the fear of many central-station men when high-efficiency lamps were first introduced, lest they would reduce revenues. It was soon found, however, that the public is more interested in increasing illumination than in reducing bills. The new lamps not only were very popular, but stimulated a desire for electric light by many who were using other forms of illumination. The result has been that electric lighting has been revolutionized in the last 18 months and is to-day in a competitive position as to cost with all other forms of illumination. It is generally conceded that a well-lighted city is a well-advertised city. A visitor's impression of the progessiveness of a city is, to a large extent, created by the illumination of its business district. An ornamental, uniform system of illumination has been installed in a number of cities in Minnesota. Whatever system is adopted, it should be artistic by day as well as by night.

Mr. Gille believed all would agree that we can well afford to devote more thought and care to our public relations in the future than we have in the past. No detail which has any bearing on these relations should be overlooked or neglected. The success of any enterprise is dependent on the successful use of its products, which includes the maintaining of friendly relations with customers and the public. Referring to the benefits central stations derive from educational advertising, he said that the necessity for some such demonstration on a large scale in the Northwest resulted in the formation of the Northwestern Electrical Show Association, which was responsible for the show just closed. He suggested that an electric building at the Minnesota State Fair, which is the largest fair of the kind in the country, would be very desirable. The managers of the fair are enthusiastic about the proposition, and appreciate the drawing value of electrical displays and decorations. He suggested that the association publish brief abstracts of all rate decisions by courts and commissions, including those of the Interstate Commerce Commission, affecting the fundamental principles of rates and service.

Mr. Gille then took up water-power development and conservation. He estimated that if the statement of the chief hydrographer of the United States Geological Survey be accepted, it is possible to substitute water-power for 19,500,000 hp generated by engines, a saving of 195,000,000 tons of coal annually, or 47 per cent of the total consumption of coal in 1908 would be effected. The building of large water-power plants helps in another way. By the construction of large reservoirs to equalize the flow from the streams, many of the beneficial effects which would otherwise be derived from the preservation of the forests are secured. Another important question in connection with water-power is the elimination of the smoke nuisance from cities. For the present, at least, the public has little to fear from extortionate charges by water-power companies. Such companies are only able, by considerable effort, to sell their products in competition with steam-generated power at prices which will yield a fair return on the investment. There is a tendency to develop powers at increasing distances from the immediate market and in large units in such a way as to secure the maximum beneficial use of the water. This tendency is toward conservation and is decidedly in the interest of the public. The profits from these, however, usually come later than from smaller projects.

Following President Gille's address, it was voted to appoint a committee to consider the recommendations made therein. This committee consisted of Messrs. Paul Doty, of St. Paul; Ludwig Kemper, of Albert Lea, and C. A. Yergin, of Owatonna.

Tuesday afternoon the first paper on the program was one by Mr. Robert W. Clark, assistant commercial agent of the Minneapolis General Electric Company, on the subject, "Developing Business." Mr. Clark aroused considerable interest by the statement that he had knowledge of an electric light and power business in a city of 15,000 population which yielded $10 gross annual revenue per capita. He also predicted that with the increasing uses for electric energy, better load factors on stations, and decreasing costs of production, feasible methods of utilizing electricity for various purposes might reasonably be expected to make a gross annual revenue of $20 per capita possible within a period of five years. This paper awakened considerable interest and was discussed by Messrs. H. A. Hildebrand, of St. Peter; E. F. Strong, of Chaska; E. Simmons, of Marshall; Ludwig Kemper, of Albert Lea; President Gille, and others.

This discussion was followed with a paper by Mr. J. R. Cravath, of Chicago, on "Street Lighting for Small Cities," which outlined the system which he considered best adapted to the general lighting of small towns, considering the revenue usually available in such towns in Minnesota. This was discussed by Messrs. R. W. Clark, of Minneapolis; Ludwig Kemper, of Albert Lea; T. C. Gordon, of Little Falls; E. F. Strong, of Chaska, and others.

Mr. Thomas Pitts, of Hutchinson, gave a paper on "Accounting" which outlined the plan employed in a small company with 300 consumers where the manager has to keep the books and meter records, in addition to his other duties. This system, in a general way, conforms with recent commission requirements in other States. After a brief discussion of this paper, Mr. Alfred Horne, of Fairmont, gave a paper giving the practical experience of the municipal plant at Fairmont (of which Mr. Horne is manager) with gas engines and producers. He outlined quite fully the troubles experienced in the early operation of this plant and the means taken to overcome these troubles. At the close of his paper, Mr. Horne answered numerous questions by various members. An abstract of this paper and discussions will be given in a later issue.

On Tuesday evening the convention attended a lecture in the Electrical Show given by Prof. M. M. Wood, in which

demonstrations of the remarkable action of the gyroscope and the monorail car were given.

Wednesday morning the first order of business was the report of the secretary and treasurer. This report showed cash from the previous year, $315.59; receipts for the year, $415; expenditures during the year, $217.21; cash balance in the treasury, $513.38.

Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, gave an informal talk on the trend of the times as regards lamps. He called attention to the fact that the lamp industry presents a situation unparalleled in the commercial history of the world in that practically all of the manufacturers in the world have come together for the technical development of the tungsten lamp. He made some interesting statements as to the research work being carried on for lamp development and things which may be expected in the lamp field in the future. He said that he was seeking for information from central-station companies as to their desires and needs in the lamp field. He stated that the tungsten filaments of great strength have been made accidentally and are likely at any time to be made systematically. He also expressed the opinion that lamps taking only ½ watt per candle are quite within the range of possibilities within the next few years. Mr. Doane's talk was discussed informally at length and the discussion drifted somewhat into the question of rates.

At the close of this discussion, a proposed amendment to the constitution was voted upon, which resulted in a change which allows central stations from North and South Dakota to become associate members of the Minnesota Electrical Association.

Mr. Paul Doty, of St. Paul, chairman of the committee on president's address, presented a report endorsing the suggestions made by Mr. Gille on various subjects, recommending the publication of decisions affecting rates and bearing on the fundamental principles of rate making, as suggested by Mr. Gille, and also urging an electrical building at the Minnesota State Fair.

A paper by Mr. Harry G. Glass, of the Westinghouse Electric & Manufacturing Company (until recently in central-station work with the West Penn Railways), took up a number of specific examples of "Central-Station Motor Applications," giving information which would be of value in planning other installations.

Prof. Geo. D. Shepardson, of the University of Minnesota, analyzed in a paper the "220-Volt Problem," taking up the advantages and disadvantages of two-wire, 220-volt systems. Professor Shepardson's conclusions seemed to indicate that no great extension of this system of distribution may be expected in the near future, although it has limited applications in small towns. This paper was discussed by Messrs. J. R. Cravath, of Chicago; Leonard Peterson, of Thief River Falls, and Sam. Furst, of Minneapolis.

Wednesday afternooen was given to sightseeing. The convention visited one of the flour mills of the Washburn-Crosby Company and from there went across the river to the three generating plants of the Twin City Rapid Transit Company, two of these plants operating by water-power and one by steam power.

Wednesday evening at 6:30 the manufacturers and dealers of Minneapolis entertained the association at an informal dinner at the Kaiserhof. President H. J. Gille acted as toastmaster and assured those present at the outset that they need have no fear of long, dry speeches, as nothing serious would be allowed. He then called on a few of the prominent manufacturers' representatives, who responded briefly, after which the meeting adjourned to attend the Electrical Show.

On Thursday morning Mr. Louis Friedman presented a short paper on the "Intensified Arc Lamp for High-Class Indoor Lighting," after which a number of questions regarding this lamp were answered by Mr. Friedman. Mr. Fred G. Dustin, chief electrical inspector of Minneapolis, read a paper on "The Grounding of Secondaries," which gave some tests carried on by the Minneapolis General Electric Company on the efficiency of iron pipe grounds and also brought out the interesting information that the city water department of Minneapolis, of which Mr. E. T. Sykes is engineer, has not only given its consent to the grounding of secondaries on water pipes, but has taken great interest and is lending support to its furtherance. This action should be of assistance in securing permission of other municipal water works and water companies to such practice. This is a matter of great importance, because it is now generally recognized that the only reliable ground in many places is to connect to a water-pipe system. Many water-works officials, however, knowing nothing of the harmlessness of such grounds, have opposed this. Mr. Dustin's paper was discussed by Messrs. R. S. Hale, contract agent of the Boston Edison Illuminating Company; H. A. Hilderbrand, of St. Peter; J. R. Cravath, of Chicago, and Ludwig Kemper, of Albert Lea.

On recommendation of the nominating committee the following officers were elected for the ensuing year: President, Mr. Robert W. Clark, of Minneapolis; first vice-president, Mr. E. Simmons, of Marshall; second vice-president, Mr. F. Bateman, of Cass Lake; secretary and treasurer, Mr. T. C. Gordon, of Little Falls. Directors: Messrs. Paul Doty, of St. Paul; B. W. Cowperthwait, of Faribault, and E. A. Aspens, of Montevideo. Following the election of officers, President-elect Clark

President-Elect Robert W. Clark.

was called upon for a few remarks, in which he stated that he had been interested in the electrical business in the Northwest for the past 16 years and that he realized the important work that was before the association the coming year, and appreciated the honor bestowed upon him. On motion of Mr. Kemper, resolutions of thanks were passed to the officers and others who had helped prepare for the convention, to those who had contributed papers, to the entertainment committee of the manufacturers and to the officers of the Northwestern Electrical Show Association. Members of the convention were admitted on pass to the Electrical Show during the week following convention.

The last session of the convention was closed by the reading of a paper on "Protective Apparatus for Electrical Circuits and Its Relation to Continuity of Service," by Mr. K. E. Van Kuren. This was illustrated by lantern slides.

Mr. Robert W. Clark, president-elect of the association, is assistant commercial agent of the Minneapolis General Electric Company under Mr. H. J. Gille, retiring president of the association. Mr. Clark was born in La Salle County, Ill., in 1870, and received a common-school education, which was supplemented in later years by a special course in the elements of electricity at St. Paul under Mr. Chas. L. Pillsbury. Mr. Clark served his time as blacksmith apprentice and blacksmith in the shops of the Great Northern Railroad at St. Paul. In

1894, being convinced that the electrical business offered better opportunities, he went to work for the Manhattan Light, Heat & Power Company, of St. Paul, on miscellaneous construction work, beginning at the bottom of the ladder. With that company he worked up to the position of general superintendent, leaving the company in 1899 to become connected with the commercial department of the St. Paul Gas Light Company. In 1903 he was transferred for a period by Mr. H. L. Doherty to special work with the Denver Gas & Electric Company, starting the campaign of that company for sign, window and decorative lighting. Mr. Clark, in connection with Mr. H. J. Gille, has invented a number of appliances in the electric sign field and is responsible for a large number of designs in sign and decorative lighting. From 1905 to 1907 he was general manager of the Union Light & Power Company of Fargo, N. D. This company gives gas, electric and steam heat service and furnishes power to the street railway. During the time of his management he rebuilt and enlarged the power plant and added to the gas plant. In November, 1907, he resigned at Fargo to become assistant commercial agent of the Minneapolis General Electric Company, his present position. He has been a pioneer in the application of the low-voltage tungsten sign lamp and has made a number of installations and has done considerable planning in connection with the application of this lamp. Some of the earliest low-voltage tungsten lamp signs were installed in Minneapolis as a result of his faith in the importance of low cost of sign operation as a factor in developing sign and decorative business.

Southern Convention of the A. I. E. E.

One of the most successful meetings of the American Institute of Electrical Engineers ever held was the Southern Convention at Charlotte, N. C., on March 30, 31 and April 1. Enthusiasm over the work of the Institute on the part of both the visitors and the Southern members was in evidence on all sides. The convention marks a widening of the influence of the Institute throughout sections that gladly welcome the effects produced thereby. Although the promised attendance from the north did not justify running a special train from New York to Charlotte, yet the number in attendance exceeded that at the regular annual mid-summer conventions, the registration reaching 350 before the close of the formal meetings and exceeding 550 when the local visitors to the generating plants were included.

At the opening meeting the address of welcome was delivered by Mayor T. W. Hawkins, of Charlotte, who attributed to the hydroelectric undertakings the remarkable industrial progress of the Carolinas during the past few years. In his response President Stillwell drew attention to the widening influence of the Institute which becomes truly a national body by reason of the interest and cooperation aroused by the local meetings.

Secretary Pope announced that invitations had been received from the Southern Manufacturers' and Colonial Clubs tendering the courtesies to the visiting engineers. Both the Western Union Telegraph Company and the Southern Bell Telephone Company gave free service to the members during the convention. The headquarters of the Institute were maintained in the room of the Greater Charlotte Club at the Selwyn Hotel. Special cars were provided on March 30 and 31 to convey the members to motor-driven cotton spinning mills and the producer gas engine plant of the Charlotte Consolidated Construction Company. During the afternoon of March 31 the visiting ladies were given a reception by Mrs. Stuart W. Cramer, while in the evening the ladies of Charlotte were present in goodly number to welcome the visitors at a reception and dance held in the auditorium.

A special 10-car train provided by the Southern Power Company conveyed the members to the Great Falls station of the company, between which and the Rocky Creek station an old-fashioned barbecue was served. Opportunity was afforded to examine in detail the 60-cycle generating plants, the 50,000-volt transformer station and transmission lines, and the 100,000-volt transformer station and lines. This trip proved highly instructive to all of the visitors.

A committee consisting of Messrs. C. F. Scott, W. I. Slichter and H. E. Clifford presented resolutions expressing recognition of the substantial growth of the institute in the South and the industrial development of this section of the country, and congratulating the local committee and chairman Lee on the highly successful results of their efforts and the standard set for future conventions.

Abstracts of the papers presented at the convention and of the discussions following their reading are given below.

ELECTRIC DRIVE IN TEXTILE MILL.

A paper by Mr. Albert Milmow dealt with the use of electric motors, receiving energy from hydroelectric systems, for the operation of textile mills, particular emphasis being placed on the commercial aspect as a basis for comparison with the old form of steam drive.

The author gave estimates for the costs of electric and steam equipments for a 25,000-spindle mill requiring about 1000 hp. The electrical equipment would cost $33,897, and the steam $79,043. With electricity purchased at $25 per hp-year, steam power would have to be produced at a cost of $17.75 per hp-year to equal it in cost when all items are properly considered. However, certain economies are obtainable with electric drive, such as running several departments while others are idle. In equipping a mill for electric drive it is usual to provide one or more motors for each process of the work so that in case the demand on that department is increased, it is possible to work over-time on that particular department, where, on account of the inefficiency of the engine at light loads and often because of the very small part of its capacity that is required, it would be impossible to run with a steam drive; or if some department, such as the twisters, is not needed at all, the motor provided for it can be shut down entirely, thereby saving all of the expense of its operation without affecting the operation of any other department or in any way affecting its speed. These points are actually taken advantage of and practiced to a very great extent. In mills using automatic looms they are frequently left in operation at the noon hour, when they will run until some threads break, when the loom automatically stops itself and remains stopped until the weaver returns. Many of them continue in operation without interruption. In some cases looms are left in operation after shutting down time until the loom stop itself, which often does not occur until all the filling yarn is exhausted. These hours in the aggregate sum up a very respectable total in the course of the year.

It has been found that in practically every mill that has been converted from mechanical to electric drive, an increase in production has been obtained. This is almost always the case and it is not usually taken account of by investigators of the cost of operation. Among the uninformed there is a quite general opinion that the converted mill takes to operate it electrically as much as or more power than it previously did with steam. On account of the increased production with the electric drive this is true in a great many cases; but in many other cases it is uncertain, as no accurate records of steam indications have been taken or kept. The explanation of this increase in power is simply that the production has been increased. At the time the motors are installed the speeds of the mill are readjusted and nearly always increased, the power is applied more directly to the work with less chance of slippage of belts and, above all, the speed with motor drive is much more constant.

In hydroelectric systems for distributing energy to cotton mills it is found to be impracticable to place a substation for each consumer where several mills of small or moderate size are installed in one town. This is on account of the large first cost of a substation reducing the e.m.f. from, say, 100,000 volts, and also on account of the difficulty of running the high-tension mains through cities and towns. On account of the high cost of transmitting energy at low secondary voltage for any con-

siderable distance, both as to initial investment and in power loss, the Southern Power Company found it necessary to adopt 2200-volt motors in mills where the general practice had been to use motors of 550 volts, 400 volts and even as low as 220 volts.

At first considerable prejudice existed among the mill owners and the underwriters against the use of high-voltage motors, but some years of experience have demonstrated their superiority in every way. The first cost is about equal to that of the lower voltage motors. Their efficiency is equal and the slip is also equal or somewhat less. With an equipment of 2200-volt motors energy can be transmitted with an economical loss and reasonable first cost to a distance of approximately 1.5 miles from the central substation.

In many of the older low-voltage installations, for the sake of economy, open wire is run in the mill. The cost of installing it in conduit would be excessive on account of its size. And also on account of the size of the wires and the very extensive system of feeders, it is only a matter of time until open wiring becomes disarranged, due to its being swept to remove the lint and dirt which it accumulates. Another serious feature of this system is the frequent and necessary employment of fuses to protect smaller branches.

The author stated that probably 90 per cent of the motors burned out in the mills under his charge have been damaged by the failure of one of the three fuses of the three-phase circuit, thereby leaving the motor operating on a single phase, which eventually destroys it. On account of increases to the mill equipment, or bad initial calculations, the wiring loss in the mill often runs up to very high figures with the lower voltages.

In mills using 2200-volt motors, the wiring is run in iron or steel conduit and consists of three-wire insulated cable with lead sheaths. The loss in this system is very low, the cost is low, and complete protection is afforded by means of automatic oil switches. The size of the wires is very small, and the whole system takes up less space in a mill and is no more conspicuous than water and sprinkler pipes. On account of grounding the conduit, the liability to accident is practically eliminated.

DISCUSSION ON TEXTILE MILL DRIVE.

In the discussion of Mr. Milmow's paper Mr. C. F. Scott called attention to the numerous incidental advantages of the electric-motor drive over the steam-engine drive, including convenient subdivision of machine grouping, elimination of friction, uniformity of speed, ease of speed adjustment, maintenance of maximum output, rating, etc. Thus, the electric drive provides increased output and improved economy by reason of its better quality.

Mr. W. S. Lee remarked that when accurate records are kept of the instantaneous performance of each machine used in a textile mill the manager can detect readily any irregularity in operation, and thus can improve the output by accelerating those sections exhibiting a tendency to retardation from unnecessary causes, such as inattention of the operators many minutes before the time for bringing the mill to rest at the end of the working period. Of prime importance in textile mills is the uniformity of speed if the quality of the product is to be of the highest. Any instantaneous variation in speed means broken threads and other sources of delay. With the electric drive not only is the average speed constant, but the speed is truly uniform from instant to instant.

Mr. D. B. Rushmore stated that the introduction and expansion of textile mills in the South represent the transition of the community from a purely agricultural to an industrial characteristic. The use of electric motors instead of steam engines means increased and improved product at lessened cost. For supplying energy to the motors the hydroelectric transmission system is evidently more economical and satisfactory than the isolated plant arrangement.

Mr. L. T. Robinson said that among the many advantages of the electric method of driving textile mills not the least important is the ability to use automatic recording instruments for showing just what service each motor is called upon to perform and thereby indicating the exact condition of operation of the mill at all times.

GAS ENGINES IN ELECTRIC SERVICE.

Much interesting information concerning the operation of gas engines in electric railway and lighting service was given in a paper by Mr. E. D. Latta, Jr. The author gave a description of the apparatus and equipment in a small but thoroughly appointed central station, namely, that of the Charlotte Electric Railway Company, using gas engines for prime movers, and supplying energy for street railway purposes, electric lighting, and motors in small units. He also gave from the daily operating reports, some figures from which can be formed an idea of the reliability, efficiency and adaptability of the plant under conditions which are relatively as severe as can well be imposed upon any plant, whether large or small, and some data on the subject of producer-gas manufacture.

The equipment described consists of two 810-hp horizontal twin-tandem, double-acting four-stroke cycle gas engines and one 60-hp single-tandem exciter engine, in general similar to the large engines. The 540-kw, three-phase, 60-cycle, 2300-volt alternators are directly and rigidly connected to the crank shafts of the main engines, and a 40-kw, direct-current generator is directly connected to the exciter engine. In addition to this apparatus there is an induction motor-driven exciter set of the same rating as the engine exciter, a 300-kw and a 500-kw rotary converter, and the usual switchboard equipment.

The author remarked that it is generally supposed that the angular velocity of a gas engine is uneven and characterized by periodic variations with each impulse, due to the fact that the initial cylinder pressures are extremely high as compared to those of steam engines. This would no doubt be the case with a single-tandem, four-cycle gas engine, but with the twin-tandem engines having four double acting cylinders, eight impulses are given to the flywheel in two revolutions or one complete cycle. Therefore, as the cranks of the two sides are set at right angles, an impulse is imparted to the flywheel every 90 deg., or two impulses per stroke. The impulses thus overlapping tend to smooth out the variations that otherwise would occur, and permit of a far lighter flywheel than could be used with a single-tandem engine. The lighter flywheel is less sluggish and consequently promotes good parallel operation, but it is not too light to afford sufficient inertia to practically absorb the variations in crank effort. This statement is based on the observation of the behavior of the alternators at various times when they were running in synchronism, with the engine cranks in almost every possible relation. No difference can be discerned in the action of the switchboard instruments, whether the cranks are in step or in any other possible position.

While the parallel operation of the engines would not be considered good in comparison with steam turbines operating at high speed, with alternators having from two to four field poles, it nevertheless compares favorably with the best type of reciprocating steam engines with alternators having the same number of field poles, namely, 60, which of course means that the variations in electrical degrees will be 30 times as great per degree of angular variation as would be the case in a turbine of the same rating, which would operate at 3600 r.p.m.

The author estimated that by means of the gas-engine producer installation energy was being produced at a total cost of 0.885 cent per kw-hour, including coal, labor, repairs and all other items. The "load-factor," defined as the ratio of the output divided by the product of the engine hours by the rating of one engine, was 45 per cent.

The author stated that the economy of the gas engine has long been conceded, and its reliability at the present time has been proved without a shadow of doubt. An engine in the Edgar Thompson Works of the U. S. Steel Corporation has operated continuously night and day for six months with the total loss of only three hours' time; and other records that would do credit to any class of prime mover are to be had in numbers. That the gas engine has a wide field of usefulness is no longer disputed, but whether it is adapted to conditions of operation such as are met in the plant described is very questionable, unless it be in connection with a storage battery. Other factors, however, than the conditions of load, as in this case, often enter into the question, and bring influence to bear

upon the adoption of a system seemingly unsuitable for the conditions in hand.

When a source of energy at low price but uncertain continuity is available, a gas engine and producer will prove a most perfect relay, provided the character of service will warrant the cost of reserve equipment. With the holder full of gas and the exhauster of the producer stopped, the fires in the generators will smoulder with almost inappreciable stand-by loss. The engine may be started and put under load in less than two minutes, and the producer can be brought up to working condition before the gas in the holder is exhausted. Again, when natural or blast furnace gas is available, or when location renders the cost of fuel high, the gas engine has no competitor. Fuel that is absolutely unfit to be burned under a boiler can be utilized in the producer, but even where conditions are more favorable to steam, the gas engine makes a most respectable showing.

INSPECTION OF GAS ENGINE PLANT.

The paper on gas engines was not discussed, but immediately after its presentation the members were taken in special cars to inspect in detail the producer-gas-engine plant described by Mr. Latta. The bringing of one of the engines from rest and connecting in parallel of the 60-cycle alternators were demonstrated for the members. Although the load on the station is of a highly fluctuating nature throughout the day, the generators seemed to carry the load with equally as little hunting as is usually found with 25-cycle alternators.

LIGHTNING PHENOMENA.

An experimental lecture entitled "Some Demonstrations of Lightning Phenomena" was delivered by Prof. E. E. F. Creighton. The effects of placing a condenser in parallel with the air-gap in the secondary circuit of a spark coil were shown in a convincing manner, as were also the additional effects of shunting the gap with resistance inductive-reactance or placing resistance in series in the resonating high-frequency circuit. The selectivity of the multi-gap circuit for high-frequency rather than for low-frequency charges was well shown.

By means of an ammeter arranged to deflect a spot of light upon a scale according to the current in the circuit, the lecturer demonstrated the rapid formation and slow dissolution of the film upon aluminum electrodes surrounded by borax electrolyte contained in glass jars. The film acts as a counter e.m.f. to limit the current produced by the line e.m.f. When the e.m.f. is first impressed upon the aluminum cell upon the electrodes of which there are no films, the current reaches a high value and the electrodes become luminous; the film begins to form immediately, at a rate depending upon the excess of the impressed over the counter e.m.f. of the cell, and the current rapidly decreases to an inappreciable value. The initial value of the current and the final steady value depend not only on the condition of the film, but also upon the impresed e.m.f. With an e.m.f. much in excess of 330 volts even the final current becomes large and the heating effects excessive. The rate of dissolution of the film depends upon the temperature and the composition of the electrolyte. At high temperature the film disappears rapidly, while at very low temperature it remains in proper condition almost indefinitely. Both the rate of dissolution of the film and the resistance of the cell depend upon the composition of the electrolyte, and by altering the composition the characteristics of the cell can be changed to suit the varying service requirements. Even a small amount of chlorine is detrimetal to the performance of the cell. On account of the loss occasioned when the cells are connected permanently in circuit it is preferable to insert an air-gap in series with the cells when used with alternating current and arrange to short-circuit the gap once per day for a short time. When used across a direct-current circuit there is no need for the series gap, as the loss and heating are inappreciable.

FURNACE ELECTRODES.

A paper by Dr. A. E. Kennelly devoted to certain modifications in Hering's laws of furnace electrodes introduced by including variations in electric and thermal resistivity. In their simplest form the relations brought forward by Mr. Hering were based on the assumption of uniform and constant conductivity for heat and for electricity. In actual furnace electrodes the conductivity is not the same at the cold end as at the hot end. The modifications introduced by reason of the different conductivities throughout the electrode were investigated mathematically by Dr. Kennelly. The author assumed that both the electric and thermal resistivities are known at the hot end, as well as at the cold end of the electrode, from physical data for the electrode material at the furnace temperature and at the external air temperature. He assumed also that both resistivities change uniformly according to a straight-line law from the known value at the cold end to the known value at the hot end.

As a result of this investigation Dr. Kennelly found that in the general case when both resistivities vary, the minimum heat-waste is found when the joulean flow through the external end is equal to the furnace flow. This is the same relation as was stated in Mr. Hering's original paper. Whereas, however, the joulean flow through the outer end was pointed out in that paper to be half the total joulean flow with constant resistivities, it is not, in general, half the joulean flow when either one or both of the resistivities can vary.

Within the assumptions to which the above inquiry has been confined, Mr. Hering's first two laws may be amended as follows, to meet the conditions of variable thermal and electrical resistivity.

a. The combined loss through the cold end of an electrode is equivalent to the sum of the loss by heat conduction alone (when there is no current) and approximately half the I^2R loss, the exact fraction depending on the temperature coefficients of the resistivities. With constant resistivities, the fraction will be one-half.

b. The above combined loss will be least when the loss by heat conduction alone is equal to the joulean loss through the cold end. The total loss will then be approximately equal to the total joulean loss and very little heat will flow into or out of the furnace. With constant resistivities, the resultant furnace flow will be nil.

A second paper dealing with furnace electrodes was presented by Mr. Carl Hering, who outlined the proportions to be used in designing the electrodes for the maximum efficiency in operation. An abstract of this paper is given elsewhere in this issue.

DISCUSSION ON ELECTRODES FURNACE.

In a written communication Dr. A. E. Kennelly called attention to the very interesting conclusions that for the conditions obtaining in electric furnace operation copper is a better electrode material than is carbon, with reference to the efficiency. He mentioned also that the errors involved in the simple method of calculation proposed by Mr. Hering are even less than the small values shown in his paper, for the data actually found in electrodes are more favorable than those he had assumed.

Dr. E. F. Northrup submitted a written contribution to the discussion in which he described an extremely simple mathematical demonstration of the Hering laws not involving the calculus.

In discussing Dr. Kennelly's paper, Mr. Hering expressed his high appreciation of the author's work in bringing to a definite conclusion his mathematical analysis of the errors involved in assuming mean values for the non-uniform thermal and electrical conductivities in furnace electrodes when proportioning them for the minimum loss. His demonstration represents the best type of application of mathematics as a tool for workmen rather than as a means of entertainment for theoretical physicists.

President Stillwell remarked that the development of electric furnace processes which can be carried on intermittently is of much importance to hydroelectric transmission systems. Such processes will prove ideal as loads for the system during the non-peak hours when energy can be supplied at a comparatively low price.

PARALLEL OPERATION OF HYDROELECTRIC PLANTS.

A paper by Mr. W. S. Lee outlined some of the advantages to be gained by operating a system of hydroelectric plants connected in parallel so as to exchange energy from one plant or territory to another. The advantages enumerated are economic ones, based on the fact that the extreme conditions of low water or flood water do not affect all streams or parts of the same stream similarly or simultaneously. When the plants are located on the same stream, the flood waters may not appear simultaneously at all of the plants along the stream.

The low-water problem can be handled much more advantageously when plants are located on different streams as it is rarely the case that areas of abnormal rainfall or lack of rainfall extend over different valleys and different parts of them to the same extent. The rainfall may vary a great deal even in the same valley, but this variation is always more pronounced in different valleys. Just as the effects of low water are minimized by having plants on different streams, so are the effects of high water. The floods that interfere with the operation of plants are the large ones, and it is a very rare occurrence to have a large flood on two different streams at the same time. There may be heavy rains in one part of the valley causing an excessive local flood that will not affect a plant located 30 miles or more below, and the upper plant can be put back into commission before the flood will affect the plant lower down, and so on.

It is evidently advantageous to have a chain or system of plants in connection with the storage of water. When the plants are connected together in parallel it matters not what size reservoir each particular plant may have, as all the water can be made available by the operator as if it were in one large reservoir. This, of course, will make it necessary for the operator to draw continuously on plants that have small reservoirs, using the plants with large reservoirs in cases of emergency or heavy peak loads.

The matter of first consideration to the hydroelectrical engineer of any system, great or small, is reliability of service. If there are advantages in operating generating plants in parallel there must be still greater advantages in supplying customers with energy from one general transmission system. The large transmission system presents many possibilities for belt lines and tie-in lines, which strengthen the service and which would not be possible on a small isolated system. Duplicate lines can be so laid out that while they are not built close together they eventually reach the same point. By this plan they reach and serve separate territories and come together at a fixed point, there furnishing duplicate service. In case of interruption to one line, energy can often be furnished from another direction until necessary repairs can be made. When a large transmission system is laid out to serve consumers to the best advantage, it is an easy matter to tap the system and take additional energy from any new generating station.

DISCUSSION ON PARALELLING OF PLANTS.

Mr. C. E. Waddell remarked that when several plants are operated in parallel the regulation is much more satisfactory than when the load is subdivided and carried by several small stations. When the supply of energy throughout a large territory is controlled by one company the customers obtain the advantages of uniformity of rates and ability to obtain advice in the selection of equipment and assurance of low prices from manufacturing companies. The existence of a large hydroelectric company tends to encourage the industrial development of the territory served.

Mr. P. H. Thomas called attention to the advisability of finding some purpose for which the "overflow" energy of a hydroelectric system can be used during non-peak hours or low-load seasons.

Mr. D. B. Rushmore said that the variation in the flow of water from season to season is the greatest disadvantage under which a hydroelectric system must operate. This variation usually requires the installation of auxiliary equipment in order to insure reliability, as is the case at Los Angeles, where steam engines are used, and San Francisco, where gas engines are in service.

Mr. A. M. Schoen advocated the adoption of the same standards by systems operating in adjacent territory in order that they may interchange energy and thus assist each other in case of emergency.

Mr. Carl Hering said that many of the electrochemical processes can be operated intermittently so as to use energy only during the low-load periods. The electricity supply companies can obtain this type of load by offering the energy at low rates for the intermittent processes.

Mr. H. N. Muller remarked that such processes are now being employed in Pittsburgh where energy for the purpose is sold at 1 cent per kw-hour.

Mr. W. L. Waters pointed out the many desirable features of the induction generator for service where many hydroelectric stations are operated in parallel, laying particular emphasis on its simplicity. With this type of generator use must be made of some external source for supplying the exciting volt-amperes. In the case of the Southern Power Company's 100,000-volt transmission line the leading wattless charging kva has a value of 6000, which is sufficient for exciting, say, 20,000 kw in induction generators.

Mr. C. F. Scott outlined the features of the system of the Southern Power Company, which distributes energy over a very wide area. The problems relate largely to the switching arrangements which must be employed.

Mr. E. W. Shedd expressed the opinion that the haulage of freight by electric locomotives operated only at night would prove a highly desirable non-peak load on a transmission system.

Mr. L. B. Stillwell claimed that on account of the public service rendered by them hydroelectric companies should be given the right to condemnation even more readily than railroad companies. The service should be regulated by State commissions and the developments should be encouraged in every way, thus permitting the most effective conservation to be undertaken by the utilization of energy now being lost irrecoverably.

Mr. R. W. Pope cited several cases to show to what extent the obstinacy of a very few land owners may obstruct developments that are of advantage not only to the community as a whole but to the individual land owners as well.

In closing the discussion Mr. Lee showed that where a steam plant is used as auxiliary to a low-head hydroelectric development it is advantageous to operate the plants in such a way and at such times as always to obtain the maximum head from the water rather than to allow the head to be much reduced before employing the steam equipment. Good voltage regulation from an extensive network of high-tension distributing conductors may be obtained by using the proper taps on the lowering transformers. The Southern Power Company has arranged to install a 10,000-kw, steam-turbine auxiliary plant with alternators to assist at all times in maintaining the proper distributing voltage and expects later to install an additional 6000-kw equipment for the same purpose.

PROTECTION OF LINE INSULATORS.

The experiences and experiments of the Niagara, Lockport & Ontario Power Company leading to a method for protecting insulators from lightning and arcing effects were described in a paper by Mr. L. C. Nicholson. The lines of this company from Niagara Falls to Syracuse were placed in service in July, 1906. During the lightning season of 1906, 35 insulators were disabled by puncturing or shattering out of a total of 12,000 installed. An analysis of the insulator failures with respect to their location showed a very remarkable result. The number of insulators disabled on the top wire was four times the number disabled on a single side wire, or twice the number disabled on both side wires. This result formed a basis for corrective devices which were installed previous to the lightning season of

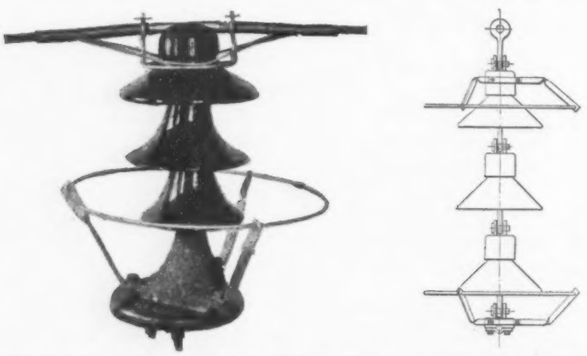
1907. These devices consisted of relief gaps placed on insulators at regular intervals on the top wire, and the installation of high resistances in the neutral earth connections of star-connected transformers. The gaps were spaced 2200 ft. on approximately 240 miles of line and 4400 ft. on 100 miles, while on 60 miles no gaps were installed.

The operating results of the lightning season of 1907 did not fully justify the use of the relief gaps from a theoretical standpoint, and showed them to be rather an objection than an advantage from a practical operating standpoint. It was early apparent that the gaps perfectly protected the insulators containing them, but that their protective influence was felt very slightly a short distance away on the same conductor, and was not felt at all on the two lower conductors. The net effect of the use of the gaps was to save some insulators on the top wire. The number of line breakdowns was not reduced, while voltage disturbances and momentary interruptions were numerous. For this reason the relief gaps were removed before the lightning season of 1908. The grounded horn was left in place to act as a lightning rod. The concrete neutral resistance at the generating station was retained to prevent short-circuits between any one phase and ground.

A study of the insulator failures of 1907 showed that the majority of them were due to puncture, usually from the tie-wire in the neck to the top of the pin. A few punctured vertically from the cable to the pin. Approximately 25 per cent, and perhaps more, were shattered by arc following a complete or partial flash-over. Comparatively few, it is believed, were shattered by direct stroke, although about 40 were injured by lightning stresses, but were not incapacitated thereby.

In view of the large proportion of punctures, it was decided to apply high potential to the lines and to weed out the weak insulators. This proved to be a slow and expensive process, so that very little was accomplished before the advent of lightning in 1908. A three-minute test of 100,000 volts to ground was applied to 109 miles of line containing 4000 insulators, and resulted in the puncture of 80. The lightning season of 1908 was a particularly severe one, resulting in the destruction of 226 insulators and the injury of 100 more.

The author described a device for rendering insulators fireproof, or rather proof against injury by arc in the event of a flash-over, which was developed to meet an obvious need. As shown by Fig. 1 this device consists of two metal rings concentric with the insulator, a lower one which is situated near the base being considerably larger in diameter than the insulator



Figs. 1 and 2—Arcing Rings on Pin and Suspension Insulators.

parts, and supported by grounded metal risers attached to the pin; and an upper one somewhat larger than the neck of the insulator, just opposite the tie-wire, suspended from the transmission cable, and electrically connected to it. Details of construction are evident from the illustration.

These rings serve as electrodes, to which the arc automatically transfers immediately after its formation between the tie-wire and pin, over the surface of the insulator. When holding between these rings, the arc is removed sufficiently from the insulator to prevent injury to the porcelain by heat.

It was determined experimentally that the intense and concentrated heat at and near the ends of a large arc is largely responsible for the damage wrought. This is particularly true of the lower terminal which passes up the pin to the heart of the insulator and shatters it. In other words, the insulator is broken from the bottom upward, by the lower end of the arc. The upper terminal, located on the tie-wire, is not so destructive, on account of the tendency of the arc to flare upward and away from the porcelain. If, however, the very crater of the arc comes into actual contact with the porcelain, by reason of being located on the nether side of the tie-wire, or by reason of burning the tie-wire in two, which it may do if it remains at a single point, the headpiece of the insulator will be broken. Under wind conditions the arc hides behind the insulator on the leeward side and remains at or near one place on the tie-wire, sometimes burning it in two, and by coming into actual contact with the porcelain causes a breakage of the headpiece, but only the headpiece. The cure for this condition proved to be the use of the second ring about the head of the insulator, separated at all points from the porcelain. It was located just oposite the tie-wire, and of sufficient thickness fairly to resist serious burning.

Before the lightning season of 1909 all of the insulators on one of the duplicate lines and on some of the important branches, 195 miles in all, with more than 11,000 insulators, were removed from the line and subjected individually to a three-minute dry flash-over test at 195,000 volts from a 50-kw, 25-cycle testing transformer. Those which withstood this test were returned to the line, and were installed on the two lower wires exclusively. On the top wire where most damage by lightning had occurred in the past, and on the lower wires to the extent necessary to accomplish their insulation, use was made of a special new type of insulator. This is a four-part insulator of about the same outside diameter as the old-style three-part insulator, but considerably shorter, 6 in. in fact. It flashes over dry at 190,000 volts, and wet at 105,000 volts.

An insulator of this design was selected in the light of experience, which clearly indicated that long insulator parts can ill resist the mechanical stress of lightning shocks, and that three thicknesses of porcelain are not sufficient safely to resist puncture in insulators having high flash-over characteristics. Moreover, short shells allow sufficient creepage at high voltage to effect a more nearly uniform distribution of potential upon the several parts, which prevents the puncture of any single shell by a disproportionate division of potential. In short, this four-part insulator was designed to flash over rather than to puncture, and to do this with some margin of safety against puncture.

The second of the duplicate lines was not tested or protected in any way. Since both lines are on the same right-of-way for a considerable distance, and in general pass through the same section of country, being at most a few miles apart, a definite comparison of the operation of the two lines for the lightning season of 1909 shows the value and effectiveness of the reinsulation and arcing-ring protection. Also a comparison of these results with those of former years is of interest.

Table I gives a comparison of lightning effects on the reinsulated lines during 1909, and on the same lines previous to reinsulation during the years 1907 and 1908.

Table II gives a comparison of the lightning effects on the non-reinsulated lines of 1909 and on the same lines in 1907 and 1908. These tables are self explanatory. Attention is called to the extra severity of the lightning season of 1908, and to the fact that the lines which were reinsulated in 1909 had formerly received rougher treatment than had the other lines.

From Table II it apears that lightning effects in 1909 were slightly more than half those in 1908, and somewhat in excess of those in 1907. It is therefore believed that the reinsulated lines have been subjected to a lightning season of average intensity.

In view of the extensive use of suspension insulators, some

experimental work has been carried on which indicates the necessity for, and effectiveness of, arcing ring protection on this type of insulator. The author stated that the arrangement shown in Fig. 2 apparently accomplishes the desired results.

DISCUSSION ON INSULATOR PROTECTION.

Mr. F. P. Catchings related his experience with spark-gaps placed across each insulator in a 30,000-volt transmission system. During the past year only two insulators thus equipped were destroyed.

Mr. J. W. Fraser stated that the arcing ring protects the insulator but does not prevent short-circuiting or grounding the line. He expressed the opinion that the factor of safety with insulators is too small. The doubling of the present factor of safety would increase the cost of the total system by only from 5 to 7.5 per cent.

Prof. E. E. F. Creighton said that an overhead ground wire is preferable to protecting rings around the insulators because when it is used the formation of an arc is prevented and induced strokes do no damage to the line and cause no interruption to the service. He called attention to a spark recorder now being placed on the market for investigating the character and location of electrostatic disturbances along a transmission system.

Mr. J. A. Jenks said that discharge gaps at each insulator have proved signally effective in protecting the 25,000-volt insulators along the 185 miles of lines of the West Penn Railway Company. Use is made of insulation, factor of safety of

TABLE I, SHOWING LIGHTNING EFFECTS ON REINSULATED LINES DURING 1909, AND ON THE SAME LINES BEFORE REINSULATION DURING 1907 AND 1908.

Item	1907	1908	1909
1. Insulators disabled	59 (*a*)	139 (*c*)	1
2. Insulators injured (serviceable)	16	35	13
3. Occasions on which a line was disabled by the breakage of one or more insulators	12	26 (*c*)	1
4. Short-circuits or grounds which tripped controlling circuit-breakers but did not disable the line	32 (*b*)	38 (*c*)	19
5. Number of days on which lightning was observed at one or more points on the system	41	54	44

(*a*) Low, on account of relief gaps.
(*b*) High, on account of relief gaps. This is one-half the total number on the entire system. In addition there were 100 grounds and short-circuits on the system which did not trip circuit-breakers.
(*c*) High, on account of severity of season.

TABLE II, SHOWING LIGHTNING EFFECTS ON THE NON-REINSULATED LINES OF 1909, DURING 1907, 1908 AND 1909.

Item	1907	1908	1909
1. Insulators disabled	29	81 (*b*)	54
2. Insulators injured (serviceable)	15	66	36
3. Occasions on which line was disabled by breakage of one or more insulators	9	23 (*b*)	15
4. Short-circuits or grounds which tripped controlling circuit-breakers but did not disable the line	32 (*a*)	42 (*b*)	12 (*c*)
5. Number of days on which lightning was observed at one or more points on the system	41	54	44

(*a*) High, on account of relief gaps. This is one-half total number of entire system. In addition there were 100 grounds or short-circuits on the system which did not trip circuit-breakers.
(*b*) High, on account of severity of season.
(*c*) Low, on account of operating practice of removing voltage from 110 miles of line during lightning storms.

five, throughout the whole transmission system, but no overhead grounded wire is installed.

Mr. C. F. Scott questioned the need for a 4-to-1 or a 3-to-1 factor in the insulators for very high voltages, his argument being that an excess of, say, 100,000 volts would be sufficient under all conditions quite independent of the value of the operating e.m.f.

Mr. P. H. Thomas remarked that the arcing rings eliminate puncturing and shattering of insulators while the resistance between the neutral and earth is of assistance in limiting the short-circuit current and rupturing the arc. He claimed that the overhead grounded wire furnishes excellent protection, but is quite expensive.

Mr. J. A. Sanford, Jr., claimed that the insulator manufacturers are willing to employ higher factors of safety and are already doing so.

Mr. E. B. Merriam called attention to the low resistance of an arc carrying generator current which is approximately equal to that of an equivalent length of No. 4-0 copper wire.

In a written communication to the discussion, Prof. H. J. Ryan explained the electrostatic stresses around an insulator equipped with arcing rings, and showed that the protection to the insulator is attributable to the altered distribution of the electrostatic lines of force.

In closing the discussion, Mr. Nicholson stated that the heating effect of the arc may be limited to a value below that required for destroying the insulator by inserting a fuse in the circuit. The fuse will blow before the insulator becomes hot enough to be injured.

New York Public Service Commission News.

It is said that within the next 10 days, the Interborough Rapid Transit Company will submit to the Public Service Commission of the First District of New York an amended plan for the construction of new subways. This plan is the outcome of the numerous conferences that have recently been held between the officials of the company, the Mayor and the commissioners. The company has conceded some points in order to meet the views of the commissioners. The Interborough company at the present time is receiving about 15 new cars each week and the service both in the subway and on the elevated lines has been vastly improved. The routes proposed by the Interborough include a line under Madison Avenue from Grand Central Station to the Harlem River, a line under Seventh Avenue from Times Square to the Pennsylvania Railroad terminal and another East River tube to Brooklyn. Chairman Willcox, of the commission, announces that advertising for public hearing on the forms of contract for the Broadway-Lexington Avenue, Broadway-Lafayette Avenue and Canal Street subways will probably begin some time next week. Under the law, this hearing must be advertised for at least two weeks before it is held.

The railroads committee of the New York Legislature has voted to report favorably the Parker bill amending the Public Service Commission's law. The principal amendments embraced in this bill give to the commissions the power to investigate the affairs of holding companies. It also gives the commissions the right to fix reduced fares for school children and to order transfers on any surface lines in the State. The same powers that are extended to the commission over railway lines are also given with regard to gas and electric light companies.

The Public Service Commission, Second District, has authorized the Hoosac River Electric Light & Power Company to issue its capital stock in the amount of $15,000, to be sold at not less than par. The proceeds are to be used for discharging indebtedness incurred in erecting its plant at Valley Falls, the expenses incident to further construction and extensions in that village, and the cost of necessary equipment for a distributing system in the village of Schaghticoke; authority has also been given to said company to exercise franchise in the village of Schaghticoke, granted to it by the Board of Trustees.

The commission will hold a hearing in the matter of the application of the Auburn & Syracuse Electric Railroad Company and Auburn & Northern Electric Railroad Company asking for rehearing of the matter of the commission's order of Jan. 31, 1910, requiring said companies to lay a double track in place of an existing single track upon State Street in the city of Auburn. The Auburn & Syracuse Electric Railroad Company contends that in order to improve its service it is necessary to change its line between Skaneateles and Auburn from single to double track and remove it from the highway, and that such change is more urgent than the one ordered by the commission. The Auburn & Northern Railroad advances the statement that since the opening of the Rochester, Syracuse & Eastern Railroad the travel between Auburn and Port Byron upon the applicant's road can be adequately taken care of without the double-tracking of State Street.

The Public Service Commission, Second District, has authorized the Hornell Electric Company to issue 175 shares of its common capital stock and to exchange the same for certificates of indebtedness issued on May 1, 1908, and maturing May 1, 1931. The Corning Gas & Electric Company has been authorized to exercise franchises in the hamlet of Gibson, Steuben Count. The company is authorized to supply gas and electricity in the township in question.

The Fulton County Gas & Electric Company has been authorized to issue its three-year, 6 per cent gold bonds for the aggregate principal sum of $99,000, the notes to be dated March 1, 1910, and to be redeemable at the option of the maker any time after Sept. 1, 1910. The notes are to be sold at not less than par. The proceeds are to be used for extension and improvements to the gas and electric properties of the company in Johnstown and Gloversville.

Wisconsin Rate Commission News.

The Wisconsin Rate Commission recently ordered a readjustment of the rates charged by the Ripon Light & Water Company without materially affecting its revenues. The action arose upon the petition of the city of Ripon, filed October, 1907, alleging excessive rates and poor service. The commission made an exhaustive investigation of the financial condition of the company and determined that the rate return which was being earned was not unreasonable.

The old schedule of rates, however, was open to the fatal objection that the discount system used by the company created discrimination between consumers. Under the old system it was possible for a certain consumer to have a larger bill than another consumer whose meter showed the use of a larger amount of energy. The commission says "it is a feature giving rise to frequent complaint and its continuance is deemed inadvisable." The schedule of rates fixed by the commission was based upon a careful analysis of the cost of service, which was found to be as follows: 24.5 cents per kw-hour for one-half hour's operation daily; 16.88 cents for one hour's operation daily; 13.07 cents for two hours' operation daily; 11.79 cents for three hours' operation daily.

The following schedule of rates was ordered effective: *Primary rate.*—Sixteen cents net, or 17.75 cents gross, per kw-hour for energy used equivalent to or less than the first 60 hours' use per month of the active connected load. *Secondary rate.*—Nine cents net, or 10 cents gross, for all energy used in excess of the above 60 hours' use per month of the active connected load. The minimum bill is to be 75 cents and a 10 per cent discount may be allowed on the gross rates for prompt payment.

There are five classes of active load, as follows: Class A, residences, public buildings, Ripon College, etc., 40 per cent active. Class B, schools, churches and industrial establishments that close not later than 6 p. m., 55 per cent active. Class C, livery stables, hotels, etc., 60 per cent active. Class D, stores, offices, banks, saloons, etc., 79 per cent active. Class E, signs, etc., 100 per cent active.

The total revenue from consumers will be slightly increased, while the revenues received from the city will be decreasd. The rate for arc lamps was reduced from $80 per lamp per year to $78 for midnight service, and from $70 to $58 for moonlight schedule service.

An examination of the financial condition of the gas plant showed an actual loss of revenue when all facts were taken into consideration. This plant furnishes oil-gas, and, although the basic rate of $6 per 1000 cu. ft. appeared excessive, the actual monthly consumer bills, with discounts, were found to be practically the same as in the average city where coal or water-gas is supplied. From tests made by the commission it was evident that the respondent company had recently reduced the quality of its gas. To insure adequate service from oil-gas plants, rule 8 of the commission's order regarding standards for gas has been modified to read as follows: "The company furnishing gas which, within a one-mile radius of the distribution center, gives a monthly average total heating value of not less than 925 pound-Fahrenheit, with a minimum which shall never fall below 850 units, may be considered as giving adequate service as far as the heating value of the gas is concerned."

The commission proposed an optional system of gas rates of $3 per 1000 cu. ft. for the first 500 cu. ft. per month; $2.50 for the next 1000 cu. ft., and $2.10 for all in excess of 1500 cu. ft. per month. The minimum monthly bill is to be 40 cents.

The commission has authorized the St. Croix Gas Company to issue 400 shares of preferred stock of the par value of $100 per share and 350 shares of common stock of the par value of $100 each. The stock is to be issued and sold for the purpose of supplying the company with funds for constructing a gas plant in the city of Hudson, Wis., and for the purpose of furnishing working capital for the carrying on of the plant.

The Winneconne Heat, Light & Power Company has been given the authority to isssue 66 shares of common stock, at a par value of $100 per share.

Massachusetts Legislative News.

The past week was one of the most strenuous in the present session of the Massachusetts Legislature in regard to electric transportation matters now before the General Court. The problem of steam railroad electrification at Boston was given a hearing by the committee on metropolitan affairs; the proposed tunnel of the Boston & Eastern Electric Railroad Company was discussed; the proposed purchase of connecting street railways by the Boston Elevated Railway Company and the question of trolley development in the Berkshire district of the State by the New York, New Haven & Hartford Railroad Company were considered. Great public interest was shown in the question of electrifying the steam railroads in the Boston metropolitan district. A large number of improvement associations located in Boston and its suburbs appeared on behalf of the various bills requiring electrification. It was argued that public health and comfort would be enhanced, private property increased in value, noise reduced, the smoke nuisance abolished and travel facilitated. Emphasis was laid upon the deleterious effects of locomotive gases on the city bridges in Boston, the annual cost of steel repairs on these structures due to locomotive fumes being estimated at $50,000 by the engineering department of Boston. Within a 10-mile radius this damage was figured at $100,000 per year. Special attention was called to the certain improvement in property conditions following electrification, notably anticipated in Back Bay apartment house districts and in the residential suburbs on the north, south and west of Boston. The possibilities of utilizing the present costly car-storage yards in the city of Boston for street and building areas were touched upon, with reference to the favorable attitude of the Railroad and Boston Transit Commissions in regard to electrification. In conclusion, the advocates of the bills urged the influence of electrification in solving the housing problem of large cities, its economies in railroad operation and its acceleration of running time compared with steam service.

In opposing the bills, Counsel William H. Coolidge, for the Boston & Maine Railroad, stated that the expense of electrification within the 10-mile radius at Boston would be $50,000,000. He contended that the New Haven had expended $5,000,000 on its lines outside of New York, without reducing expenses. He felt that the revenue to support such an investment could not be raised at Boston at present. President Adams, of the Boston, Revere Beach & Lynn Railroad stated that it would cost $1,250,000 to electrify that line, which is a narrow-gage road having practically no smoke nuisance. For the New York Central Lines, E. A. Whitman stated that it would cost $4,500,000 to electrify the Newton Circuit of the Boston & Albany system, and contended that the surburban service on this road was operated at an annual deficit of $200,000. Mayor Fitzgerald, of Boston, took a decided stand in favor of electrifica-

tion, pointing out the benefits secured at New York, and reviewing the widespread demand for the change in all parts of Boston. He urged that Boston ought not to wait for a fatal accident before electrifying, and said that he should insist upon the use of electricity in any tunnel which might be built between the North and the South Stations.

The Boston Elevated Railway Company has filed with the legislative committee on street railways a bill authorizing it to acquire the stock and securities of other street and electric railways. This measure points toward the consolidation with the Boston Elevated of all the principal electric railway systems of eastern Massachusetts, forming a single operating organization of over 1700 miles of track, and having annual gross earnings of over $23,000,000. The general scope of this plan has already been outlined in these columns.

At the hearing upon the bills to develop electric traction facilities in the Berkshire district a strong sentiment was manifested in favor of permitting the New Haven interests to undertake the work. It was argued that private capital cannot be secured on account of the lack of outlets for the new trolley lines proposed, with the contention that if the New Haven should be allowed to handle the situation, the lines could be used as feeders to the steam system in both passenger and freight service. It was stated that the New Haven management stands ready to expend $2,000,000 in trolley development if the bill is passed. About a year ago the Railroad Commission issued a report against permitting steam railroads to acquire control of electric lines, and urging that private capital can, if necessary, be secured for the Berkshire development. The advocates of the bills contended that the commission's attitude in this respect was not sufficiently influenced by the local requirements, and pointed out that the decadence of many towns in western Massachusetts is almost entirely due to the lack of electric transportation facilities. These can be supplied at a reasonable cost in relation to the topography and low density of population, and the people of that section of the State are practically united in the belief that electricity will revitalize the district industrially.

The committee on metropolitan affairs gave a hearing last week on the bill to permit the Boston & Eastern Electric Railroad Company to build a tunnel under Boston Harbor between East Boston and the city proper. The company stands ready to expend $11,000,000 upon the road immediately after authorization is secured and as soon as construction can be begun and pushed. In opposing the bill, Mr. W. H. Coolidge, for the Boston & Maine Railroad, urged that the total suburban traffic revenue in the district is insufficient to pay operating expenses, interest and taxes on the proposed road, and stated that existing companies would be greatly handicapped by competition. Mr. Arthur L. Spring opposed the tunnel on behalf of the city of Boston. The hearing was continued to enable further arguments in opposition to be heard.

Massachusetts Commission News.

A petition has been received by the Massachusetts Gas and Electric Light Commission asking that the board approve the consolidation of the Lynn Gas & Electric Company and the Marblehead Gas & Electric Light Company. The terms of the agreement provide for an exchange of one share of the Lynn company's stock for every eight shares of the Marblehead stock outstanding, and in order to provide for the purchase the Lynn company desires to issue new stock to the amount of 32,500 at $235 per share, the par value being $100. It is expected that the consolidation will result in many economies in electrical supply throughout the Marblehead district of the North Shore, repeating the experience enjoyed by the town of Swampscott since it received Lynn service.

The board gave a hearing on March 24 upon the petition of the Fall River Electric Light Company for authority to issue new capital stock to the amount of $280,000 for the payment of indebtedness incurred in new construction. Mr. Richard P. Borden, for the company, stated that the building of the new turbine plant in Fall River at tide water had necessitated the practical abandonment of the old station, which was inefficient. The cost of abandonment was $180,000. Since the work on the new plant was started there has developed a floating indebtedness of $390,000. Improvements in the distribution system are also under way. The company desires to issue the stock at $140 per share, giving a net return of 5.7 per cent. Mr. Borden did not consider this return too high in view of the hazards of the business, and particularly gas competition in the city. The hearing was continued to enable the company to present detailed statistics of its expenditures for recent improvements.

The Railroad Commission has approved the petition of the Interstate Consolidated Street Railway Company for the right to carry baggage and freight in Seekonk, and a similar petition of the Milford, Attleborough & Woonsocket Street Railway with reference to the town of Franklin has been granted. The board has authorized the Milford & Uxbridge Street Railway Company to issue new stock to the amount of $88,000 for the payment of floating indebtedness. The Dartmouth & Westport Street Railway Company has asked the board to approve an issue of stock amounting at par value to $237,500 to pay for a new freight terminal station, car-storage house, park and distribution system improvements. The company desires to issue the stock at a price of $150 per share.

The Massachusetts Gas and Electric Light Commission gave two hearings at North Adams during the past week upon the petition of Mr. Thomas Hoggerty for readjustment of charges for gas and electricity as imposed by the North Adams Gas Light Company. President Arthur E. Childs, of the Massachusetts Lighting Companies, appeared on behalf of the North Adams organization, and testified that the community has been greatly benefited by the change in administration. The hearing was of an unusually acrimonious character. The company is remodelling its motor-service facilities and endeavoring to put its service upon the best possible basis. Considerable dissatisfaction on account of the minimum charge was expressed. The company has received much hostile criticism from the local press, but is endeavoring to establish its facilities upon a permanently satisfactory basis. The officers denied the existence of discriminatory rates and contended that the company was justified in withdrawing newspaper advertisements in press mediums which spread hostile accounts of its work broadcast. The hearing was closed on March 31.

The Selectmen of Uxbridge have petitioned the Railroad Commission to investigate the service upon the lines of the Milford & Uxbridge and Worcester and Blackstone Valley street railways.

Ammeter for High-Frequency Currents.

Although the currents employed in wireless telegraphy and telephony are usually very slight in value, they frequently attain periodicities of millions of cycles per second. A meter used to measure such currents must act to integrate or sum up all the minute waves traversing the circuit, indicating the aggregate on a suitably calibrated scale.

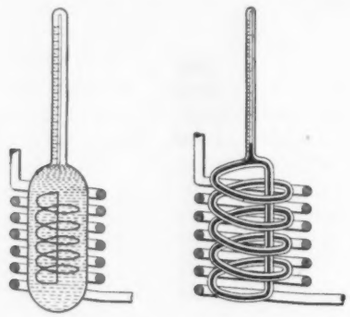
Such a meter for measuring small currents of high frequency, and based upon an induction principle in which the heat generated in an interior short-circuited coil expands a liquid, causing it to indicate in a capillary tube, has been patented by Mr. Clifford D. Babcock.

The accompanying sketches show the principle of this device. The helix represented in section in Fig. 1 carries the current to be measured, being inserted directly in series with the line from the aerial or other Hertzian-wave receiving apparatus. Within this helix is a liquid container, filled with an expansible fluid which immerses the short-circuited coil shown. Currents transversing the outer coil induce local currents in the short-circuited coil, generating heat in proportion, and expanding the fluid, which rises to the corresponding indication in the capil-

lary tube. A modification of the same arrangement provides for inserting a condenser in the local circuit; another provision anticipates making the short-circuiting connection out of platinum of relatively small diameter, so that this part will come to a higher temperature and thus impart its heat more quickly to the surrounding fluid.

For calibrating such an instrument the inventor has provided a form of container having a hollow trunk reaching up through the center of the inner coil. Into this trunk, from the outside, an iron core carrying its own independent heating coil can be inserted. By graduating the distance to which this core is inserted, by means of a screw, any desired sensitivity of the meter may be secured.

Fig. 2 illustrates another type of this induction meter, in which the short-circuited coil and expansible fluid are combined, both being represented by the mercury contained in the interior helical tube. Local currents set up in this mercury col-



Figs. 1 and 2—Ammeter for High-Frequency Currents.

umn give rise to heating, causing the fluid to expand up into the index tube, as in the other types.

The inventor states that meters of this type have proved useful for measuring unidirectional interrupted currents, as well as alternating currents of both low and high frequency.

CURRENT NEWS AND NOTES.

Meeting of Boston A. I. E. E. Section.—Mr. W. H. Blood, Jr., of Stone & Webster, Boston, was the speaker at the March meeting of the Boston Section of the American Institute of Electrical Engineers, his subject being "Fire Protection from the Engineer's Standpoint," previously presented at the Boston N. E. L. A. meeting and abstracted in the *Electrical World* of March 24, page 733. In the discussion Prof. D. C. Jackson cited the lack of information regarding a proper premium on fireproof electric plants of modern construction. Mr. M. V. Ayres, electrical engineer of the Boston & Worcester Street Railway Company, emphasized the tendency toward the construction of fireproof cars which are lighter than wooden cars, and E. W. Holst, superintendent of equipment, Boston & Northern Street Railway Company, cited the composite carhouse construction used on his lines, which is of the mill type with brick fire partition walls and small sections. In closing, Mr. Blood reiterated his opinion that the insurance rates on modern fireproof power plants are double what they should be.

Holding Court by Telephone.—Recently a trial was conducted at Warsaw, Ind., by telephone. Judge F. E. Bowser, who is quarantined because his children have scarlet fever, sat at the telephone in his own home and imposed a fine and sentence of 60 days on a young man who pleaded guilty to a charge of petit larceny.

Remarkable N. E. L. A. Growth.—We have already had occasion to comment recently on the rapid growth of the National Electric Light Association. Barely a month ago we noted its attainment of 4000 members, and now are informed that on the last day of March it reached 5000. At the present rate it promises to reach 6000 by the time of the annual convention in May, at St. Louis, and to double its members within the one year, as the total at the beginning of July, 1909, was 3138. The increase in the last six months has been very nearly 2000, and may be even above that when the executive committee meets on April 8. The growth has not been limited to any part of the country, and has been as great in Canada as anywhere else. The holding of the annual convention at St. Louis bids fair to bring large gains in the South and Southwest.

Canadian Control of Cables.—The Canadian House of Commons has passed two bills, introduced by Postmaster-General Lemieux, designed to place the control of the rates and facilities of ocean cable companies under the Board of Railway Commissioners. It is expected that the Senate will pass the bills and that they will become law at this session of the Parliament. There are five companies doing a cable business between Great Britain, Canada and the United States, namely, the Anglo-American, the Direct United States, La Compagnie Française, the Western Union and the Commercial Cable. The first two are British companies, the third is French and the last two belong to the United States.

Boston A. I. E. E. Meeting.—At a special meeting of the Boston Section of the American Institute of Electrical Engineers, to be held on April 9, at the Massachusetts Institute of Technology, Mr. H. S. Osborn will deliver a lecture entitled "High-Voltage Strains in Dielectrics."

Brilliant Aurora at Chicago.—A brilliant aurora borealis which was visible in the vicinity of Chicago, and at the Yerkes' Observatory, Lake Geneva, Wis., March 27, is explained by Professor Frost, of the observatory staff, to have been due to the solar protruberances observed the preceding week about the sun's limb. One of these eruptions appeared as a great mass of luminous gas which was expelled a distance of 250,000 miles from the photosphere. The accompanying auroral display noticed in the northern heavens at Chicago included flashes of red and green, besides the usual pearly white streaks rising to the zenith. No magnetic disturbance in telephone or telegraph lines was reported as following the solar storm or the aurora.

N. E. L. A. St. Louis, Commercial Day.—The program has been partially completed for "Commercial Day" at the coming N. E. L. A. St. Louis convention. The former practice of devoting the sessions of this day merely to papers and discussions on soliciting and advertising has given place to a new policy, and the aim of this year's program is to bring out that central-station commercialism, instead of being a mere side issue, is of similar scope and importance to central-station public policy and engineering. Among the papers to be presented is one on "Industrial Lighting with Incandescent Lamps," which is being prepared by a committee of illuminating and commercial engineers of the National Electric Lamp Association. It will be fully illustrated with views showing good and bad methods, and contain specific instructions together with reasons therefor. Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Company, of Chicago, will present a paper entitled "Latitude in Commercialism," which will set forth interesting ideas as to the real qualifications for central-station management. Other papers will be on advertising, automobiles, ornamental street lighting, residence lighting, off-peak load, prompt execution of orders, commercial department organization. The list of authors thus far comprises Messrs. H. J. Gille, Arthur S. Huey, J. D. Hoit, H. S. Hall, P. F. Pauder, R. S. Kelch, Clare N. Stannard, Frank B. Rae, Jr., C. W. Lee, H. K. Mohr, E. L. Elliott, T. I. Jones and Hayden Eames. Mr. George Williams is chairman of the Program Committee, and Frank B. Rae, Jr., secretary.

Mississippi Electric Association.—The annual meeting of the Mississippi Electric Association will be held June 15 and 16 at Greenville, Miss. Mr. J. Abbott, general superintendent of the Jackson (Miss.) Railway & Light Company, is secretary.

Engineering Education.—The Society for the Promotion of Engineering Education will hold its annual meeting June 23, 24 and 25 at Madison, Wis. Among the topics to be discussed are technical education abroad, inspection trips for technical students, and efficiency in technical education. Prof. H. H. Norris, of Cornell University, is secretary.

Long Run of Electric Automobile.—It is reported that a "Detroit" electric automobile, equipped with Edison storage battery, made a run of 162 miles on one battery charge in Chicago a few days ago. The route was from Automobile Row, in Chicago, north to Highland Park and back again by a circuitous road. This route was covered twice, with a rest between, but with one battery charge.

National Association of Cotton Manufacturers.—The annual meeting of the National Association of Cotton Manufacturers will be held in Mechanics Fair Building, Boston, April 27 and 28. Among the subjects to be represented by papers are the choice of power for textile mills; distribution of light in textile mills; the electric drive as a manufacturing proposition; progress of the Diesel engine. Mr. C. J. H. Woodbury, P. O. Box 3672, Boston, is secretary.

Projecting Electric Signs to Be Removed from Clark Street, Chicago.—Following a decision of the Mayor and commissioner of public works, of Chicago, projecting signs in Clark Street, between Randolph Street and Jackson Boulevard, are to be removed by May 1. Some time ago the Mayor received a petition asking that the signs be taken down, and as it was found that enough property owners had signed the petition to give a majority of the frontage, the prayer of the petition is to be complied with.

Portable Electric Washing Machines for "Prison Widows."—Philanthropists in Oak Park, Ill., a suburb of Chicago, have discovered a new outlet for their benevolent activities. Wives of men who are sentenced to the Bridewell for minor offenses often suffer for the necessities of life while the main support of the household is in enforced retirement. To enable these women, who are thus brought to want through no fault of their own, to make a living, it is proposed to provide them with electric washing machines mounted on wheels, so that they can be moved from house to house, and enable each woman to do two or three washings a day, where she now can do but one. This latest "uplift" proposal is ascribed to the Oak Park Fine Arts Society. It is said to be the plan to have those who wish washing done to notify the municipal judges, so that they, in turn, may notify the "Bridewell widows," who are then supposed to trundle or otherwise transport their electric washing machines to the waiting socket connection in the prospective customer's basement.

Elevated Railway Traffic in Chicago.—In studying the problem of relieving the congestion of elevated-railway traffic on the Union Loop, in Chicago, Mr. B. J. Arnold has caused actual counts to be made of the passengers passing through each of the down-town elevated railway stations. The counts were made during the rush hours and the totals show that each of the four elevated railroads carries more persons away from the Loop in the evening rush than it brings in to the same stations in the morning hours. The maximum traffic is between 6:30 and 9:30 a. m. and 4:30 and 7:30 p. m., except on Saturday and Sunday. For Northwestern and Oak Park trains the Clark and Lake Street station is the busiest one for incoming passengers. The Madison Street and Wabash Avenue station is the busiest one on the Loop for Metropolitan passengers, both incoming and outgoing. The South Side road delivers most passengers at Wabash Avenue and Adams Street, while the Madison Street and Fifth Avenue and Quincy Street and Fifth Avenue stations are very close together in furnishing the largest number of outgoing passengers.

Employers' Liability Commission.—By a recent act passed by the Legislature of Illinois and approved by the Governor, an employers' liability commission of 12 members has been created. The members of this commission are appointed by the Governor and consist of six employers of labor and six who represent the interests of workmen. The commission is to investigate industrial accidents and to inquire into the most effectual method of providing for compensation for injuries or death due to such accidents. It is to make a report to the Governor on or before Sept. 15, 1910. It is provided that the commission shall report only such recommendations as are agreed upon by a majority of that part of the commission representing the employers of labor and also a majority of that part of the commission representing the interests of workmen. The compensation of the members of the commission is fixed at the rate of $5 a day while actually engaged on the work of the commission. The commissioners are also to be reimbursed for actual expenses incurred in the work of the commission.

The Time Element.—Mr. John F. Gilchrist, assistant to the president of the Commonwealth Edison Company, of Chicago, addressed the Electric Club of that city on March 30 on "The Time Element." Mr. Gilchrist explained that he did not intend to give a dissertation on electric time stamps or even on slow-operating high-tension switches, but just a plain, matter-of-fact discussion of the time element which prevails in all lines of human endeavor. In concluding his address, Mr. Gilchrist said: "A few more minutes saved in the day, a few less idle minutes of your invested capital, a few more revolutions in a given time of the lathes and machinery in your shops or of your automobile wheels—these are factors of great importance in the struggle between success and failure." Messrs. A. A. Gray, Prof. P. B. Woodworth, W. L. Abbott and H. E. Niesz took part in the brief discussion which followed. Mr. Abbott wondered if men would ever save time enough to have leisure. He pointed out that electricity is a great time-saver in many ways—in communication, in transportation, in the home and in the factory. Mr. Niesz, who presided, also elaborated this idea briefly. A vote of thanks was extended to the speaker of the day.

Proposed Hydroelectric Development at Sterling, Ill.—By an arrangement with the United States Government, the Sterling Hydraulic Company, of Sterling, Ill., proposes to utilize the recently constructed dam in the Rock River, at Sterling, to divert water for the Hennepin Canal. When this dam was erected the Government interfered with the existing water-power rights of the Sterling Hydraulic Company and as a compensation gave the company the right to utilize the new dam for its water-power development. The Government put in the foundations for water-wheels, and the hydraulic company now proposes to go ahead with the work of erecting the superstructure and installing water-wheels and electric generators to develop the water-power at the Government dam. It is possible that the construction work required will be carried on during the present year. It is understood that a number of large manufacturing companies stand ready to take electrical energy from the new plant in considerable quantity, and while the details of the project are still under consideration, there seems to be little doubt that the proposed hydroelectric plant will be built. The Sterling Hydraulic Company has been in existence for a number of years, but prior to the building of the Government dam it simply leased water rights to manufacturers and did not itself generate electricity, as it is now proposed to do.

Southwestern Association.—The Southwestern Electrical and Gas Association will hold its sixth annual convention in Beaumont, Tex., on May 12, 13 and 14.

Neon Tube Light.—Some experiments have recently been made with neon, the newly discovered gas, as a means of obtaining light when enclosed in a tube similar to that of a mercury-vapor tube and electrically excited. The light given out was found to be of excellent quality.

Entertainment and Reception of Edison Employees.—The Association of Employees of the New York Edison Company held its annual entertainment and reception at Terrace Garden, New York City, on April 1. The entertainment feature consisted of a sketch entitled "A Military Review," presented by the Edison minstrels. A dance followed the performance.

Illumination.—A meeting of the New York Section of the Illuminating Engineering Society will be held on April 14, at which time a paper entitled "The Relationship of Fixture Design to the Illuminating Engineering Practice" will be presented by Messrs. L. R. Hopton and H. E. Watkins, and a paper on "Finite Surface Light Sources" will be read by Mr. Bassett Jones, Jr.

Proposed Mexican Hydroelectric Plants.—It is announced that the Mayo River Power & Land Company, Hermosillo, Mexico, has finished the surveys for the first of the series of three dams and hydroelectric plants that it will erect on the Mayo River in the eastern part of the State of Sonora, and that it is expected that everything will be in readiness for the commencement of construction work by the close of the coming rainy season in September next.

Exhibition of Engineers' Society of Pennsylvania.—The Engineers' Society of Pennsylvania will hold its second annual convention at Harrisburg June 1-3. The exhibit committee has announced that it has secured for exhibition purposes the new reinforced concrete building of the Central Pennsylvania Traction Company, having 26,000 square feet of ground floor space. Mr. E. R. Dasher is secretary of the society, and Mr. Fred W. Cohen, Harrisburg, chairman of the exhibit committee.

Telegraph Company can Deliver Messages by Telephone Without Extra Charge.—A decision was rendered last week in the Tennessee courts at Nashville in favor of the Postal Telegraph Company in a suit against the Cumberland Telephone & Telegraph Company by which the court held that the telegraph company cannot be compelled to pay a commission of 2 cents on every message received over the telephone lines. The court simply held that the telephone company must furnish the same service to the telegraph company that it furnished to other customers.

Special Lighting of Seventh Street, Los Angeles.—The special street lighting of Seventh Street, Los Angeles, Cal., from Hoover Street on the west to Boyle Avenue on the east, now appears to be assured. It is proposed to erect ornamental posts, each supporting four or five tungsten lamps in round frosted globes, the posts to be spaced 125 ft. apart. The total cost to adjoining property owners will be $1.75 per front foot, which will pay for the entire installation, including posts, lamps, wiring, maintenance and the necessary electrical energy. This is the price for the first year. After that the amount to be paid by the property owners will be much less. The posts have pedestals, fluted columns and ornamental capitals, above which are upward turning brackets supporting the lamps.

St. Louis Electric Show.—The public exhibition following the private display of electrical machinery and appliances at the National Electric Light Association convention in St. Louis will be open from May 28 to June 2. It will be known as the St. Louis Co-Operative Electric Show and is given under the auspices of the St. Louis League of Electrical Interests. The show committee of the league consists of Mr. Fred Adam, chairman; Mr. H. M. Spoehrer, secretary, and Messrs. W. A. Layman, Richard McCulloch, George Rosenthal and F. W. Payne. The executive committee of the league is made up of Messrs. Robert McCulloch, Walter Robbins, H. H. Humphrey, F. E. Newbery, T. O. Moloney and S. A. Hobson. Mr. F. W. Payne, the manager of the show, is addressed at the Coliseum, St. Louis, where the show will be held.

Co-operation Between Electric Clubs.—At the meeting of the Electric Club of Chicago on March 30 it was announced that Secretary F. S. Hickok is in correspondence with other electric clubs with the idea of exchanging courtesies and also announcements of meetings, etc., so that the various clubs may keep in touch with one another. Favorable responses have already been received from the Electrical League of Cleveland and the League of Electrical Interests of St. Louis. These organizations have intimated their willingness to co-operate with the club at Chicago. Correspondence is under way with other electric clubs with the same object in view. Possibly the outgrowth of this co-operation may be the formation of some sort of a league of electric clubs, but in any event it is thought to be desirable to bring about an arrangement by which members may be extended the courtesy of the local club.

Electrocuted Eggs.—The Rochester Railway & Light Company has found another use for electricity. Killing eggs is the rather suggestive description of the incipient business which is original in that city. Thus far the work has been prosecuted in an experimental way only; but should the realities in the case fulfill the dream of the electrocutionist, Mr. T. H. Yawger, superintendent of the electrical department, the possibilities of storage will be multiplied to the extent that eggs may be kept for years with the same certainty that they are now kept for months. It is claimed that when fresh eggs are put into cold storage, the eggs are alive, and they are slowly frozen to death, and that in spite of the preservative qualities of ice, the eggs thus treated do not taste good when cooked and placed upon the table. It is said that when the eggs are electrocuted their natural fresh taste remains and it is not destroyed when they are placed in cold storage. The method of killing the eggs as at present practiced in Station No. 3 in Rochester is to attach two metal caps at each extremity of the egg and to subject it to a potential difference of 500 volts.

Railway Electrical Engineers.—The semi-annual meeting of the Association of Railway Electrical Engineers will be held in Buffalo on June 7 and 8. Mr. E. M. Cutting, Southern Pacific Railway, Oakland, Cal., is president of this association, and Mr. George B. Colegrove, Illinois Central, Chicago, is secretary. Affiliated with the parent organization is the recently organized Railway Electric Supply Manufacturers' Association, which has these officers: President, Mr. W. L. Bliss, United States Light & Heating Company, Milwaukee, Wis.; vice-president (East), Mr. H. G. Thompson, Jr., Westinghouse companies, Boonton, N. J.; vice-president (West), Mr. W. E. Ballentine, Willard Storage Battery Company, Chicago; secretary, Mr. J. Scribner, General Electric Company, Chicago; treasurer, Mr. Edward Wray, Railway Electrical Engineer, Chicago. The executive committee of this manufacturers' association consists of Messrs. George H. Porter, Western Electric Company; R. M. Newbold, Adams & Westlake Company; J. M. Lorenz, Central Electric Company; A. C. Moore,, Safety Car Heating & Lighting Company; J. M. Schilling, Westinghouse Lamp Company; W. H. Glatt, New York Leather Belting Company; Charles Talbot, Westinghouse Electric & Manufacturing Company; J. Scribner, General Electric Company, and S. B. Dusenberry, Westinghouse companies, all of Chicago, and C. W. Bender, National Electric Lamp Association, of Cleveland.

ELECTRIC IRRIGATION PUMPING IN COLORADO.

Its Effect on the Summer Load Curve of the Northern Colorado Power Company.

By E. C. Reybold, Jr.

THE Northern Colorado Power Company has developed, during the last two years, sufficient irrigation pumping load to make its kw-hour output during the summer months exceed that of the winter. It is notable that during June, July and August of 1909 the output of the power plant at Lafayette exceeded that of December and January of the previous winter. Meanwhile the daily peak did not reach a point anywhere near as high as it did in the winter. In these two factors lie the great value of irrigation pumping to the electric power plant—an increased output without any increase in the peak.

Pumping in Colorado begins early in the spring, but not a great deal of it is done until May or June. Potatoes are not irrigated until the latter part of July, and as a great portion of the acreage covered by the Northern Colorado Company's lines is devoted to this crop, the heaviest load and output come at this time. Water for irrigating potatoes is used from about July 25 until about Sept. 10, and the pumps are run almost continuously during this period. The load upon a motor operating a pump is constant and the load factor of the lines supplying energy to these pumps is almost 100 per cent during this time. A single farm is irrigated with a plant of from 10 hp to 30 hp, and as each pump is usually of a size to give the motor full load it is evident that a large number of kw-hours will be used by each unit. For such crops as sugar beets and grains, the pumps are operated less continuously, but there is a longer season for them. Taken as a whole a better load could not be secured. It comes entirely off the winter peak and is almost constant.

The Northern Colorado Power Company has devoted a great deal of time and attention to this business during the past two years, and while it is now reaping the benefit of its work, it is pushing the business harder than ever. Several solicitors are employed constantly to work among the land owners, and the prospects for new business in 1910 are excellent. Where the prospects are favorable an estimate is made upon the probable income to be secured during the year, and

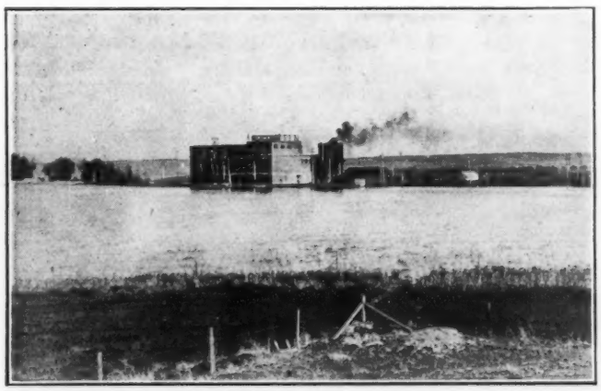


Fig. 1—Station of the Northern Colorado Power Company

the cost of the pole line to reach the plant is carefully calculated. A gross revenue not less than 50 per cent of the cost of the pole line is desired annually, and exceptions are made only when it is evident that the load will increase rapidly during the following years. If the revenue appears to be sufficient a contract is then made with the land owner whereby he agrees to pay the stated rate for electricity and also to guarantee a total revenue each year equal to the minimum desired.

The rate charged by the Northern Colorado Power Company is 3 cents per kw-hour with a flat charge of $1 per rated hp of the motor per month. By the Eaton Electric Company, which secures its energy from the Northern Colorado Power Company, a rate of 3½ cents per kw-hour is charged, with a flat rate of 50 cents per motor hp per month. With both companies the monthly charge ceases when the irrigation season is closed. One of the principle advantages in the guarantee of an annual revenue lies

Fig. 2—Packard Plant.

in the fact that each user upon a new line becomes a salesman in a way, as the power company requires only sufficient revenue from the whole line to make up the minimum, and when one owner signs up for more of an annual charge than he believes he will have use for, he immediately interests his neighbors in the pumping business in order that other motors may be installed upon the line and the minimum made up without his being compelled to make up any deficit in the total revenue required.

The Northern company distributes 44,000-volt three-phase

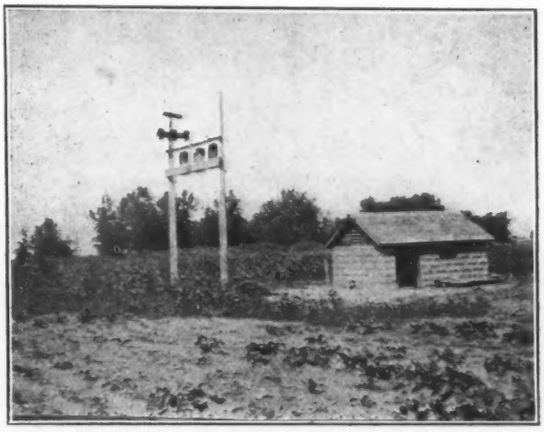


Fig. 3—Hensley Plant.

current at 60 cycles, reducing the potential to 2200 volts at each of the principal towns. The 2200-volt lines are run wherever sufficient load can be secured. When motors of considerable size are required it is customary to install 2200-volt machines, and there are many of this voltage upon the lines. For smaller motors, transformers are used and a voltage of 220 used at the machines. The transformers are usually connected in open delta. The Eaton Electric Company distributes at 6600 volts over all of its territory of Eaton, Lucerne, Ault and Pierce, and three transformers in closed delta are used in almost every case.

The size of transformers for pumping work requires careful consideration. Since the amount of energy required by a pump can be determined quite accurately, a motor is usually selected that is a trifle larger than that actually required. When once started it is possible that the pump will be operated for several weeks without any stops, and neither motors nor transformers have any chance to cool off. Such a load is very different from that upon motors in ordinary commercial service, and it will be found when efficiencies and power factors are considered that an effective transformer capacity of from 1000 to 1200 watts per actual hp used will be required to carry the load continuously.

The electric company runs its pole line to the site, and the complete pumping plant, including transformers, is furnished by the customer, who usually makes a contract with some machinery house to make the installation.

The pumps used almost exclusively are of the Byron Jackson horizontal, centrifugal type, direct coupled to motors; both being mounted upon the same cast iron base, but with a flexible leather link coupling between the shafts. These units have proved very efficient, and they run continuously without heating or end thrust and without noticeable wear. In some cases horizontal pumps are driven by belts, and in others vertical pumps are used. The rule generally followed is always to use a horizontal pump coupled direct to the motor whenever it is possible. In certain cases very low heads or the necessity of

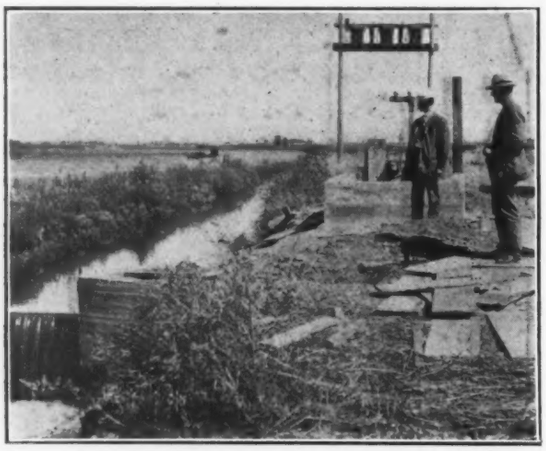


Fig. 4—Montgomery Plant.

keeping the cost of the plants down require the use of belted units, and when the water is pumped from a well or other source of supply in which it may fall to a greater distance than the suction limit of a horizontal pump (about 12 ft. is considered maximum at this altitude) it is advisable to use a vertical pump submerged in the water, an extended shaft being carried up to the level of the motor and equipped with a pulley that is driven with a quarter-turn belt. Vertical motors could be used for pumps of this kind, but the difficulty of obtaining them promptly as well as their high cost prevents their being used extensively. The capacities of the pumps in general use range from 50 up to 2000 gal. per minute, the sizes used most frequently ranging from 600 to 1600 gal. The water is pumped to heights ranging from a few feet to as much as 60 ft., and discharged through pipe lines from a few feet in length up to over 2000 ft.

The water to supply the pumps is secured most frequently from irrigating ditches that run through valuable land, just as much of which may lie above the ditches as below. It is odd indeed to see a magnificent farm on the lower side of an irrigating ditch and a desert waste on the upper, with only a 10-ft. ditch separating them. It is to make valuable land out of these dry stretches that electric irrigation is used. In some cases the water is secured from natural or artificial lakes or streams, and at times from wells. Wells are not used in Colorado to the great extent that they are in California, but their use is becoming more extended. The quantity of water that can be secured from a well is usually overestimated to the extent of several hundred per cent; but when wells are sunk through coarse gravel they may supply very large quantities of water, as, for instance, one belonging to C. S. Miner, near

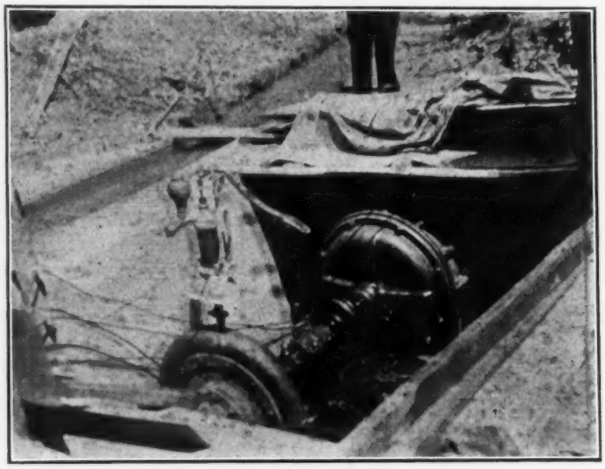


Fig. 5—Allen Plant Before Completion of Building.

Eaton. This well supplied about 3000 gal. of water per minute during 1909 without showing any indications of yielding a diminished supply.

When motors are coupled directly to pumps operating against low heads it is necessary to use slow speeds, and 900 r.p.m. is most generally employed. A few motors operate at 1200 r.p.m. for heads of about 50 ft. A point must be remembered in connection with the use of a centrifugal pump to elevate water into ditches lying at different elevations. If the motor speed is correct for the higher ditch it will be too great for the lower, and the pump will discharge a great deal more water than it should and with greatly decreased efficiency. The power required may be more for the lower than for the higher lift, peculiar as this may appear at first, and if the power of the motor is not much in excess of that actually required for the higher lift it may be seriously overloaded.

The cost of attendance for a motor-operated irrigating plant may be considered as negligible. The men who attend to the distribution of the water after it is pumped into the ditch can readily start and stop the motor, and aside from this and fill-

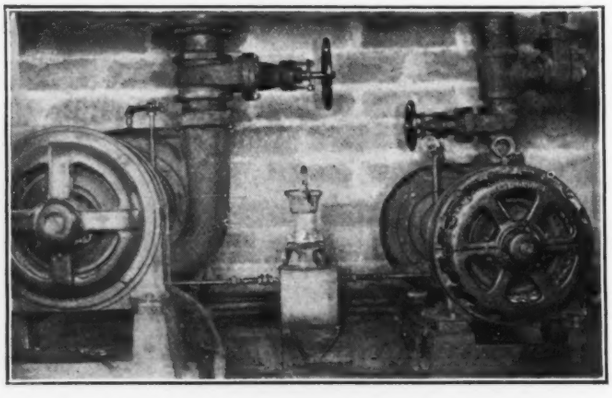


Fig. 6—Eaton Main Plant.

ing the oil or grease cup on the stuffing box of the pump once in a while no personal attention whatever is required. Many of the plants are operated continuously night and day during the height of the season, the water being set to flow in certain places at nightfall and left to run throughout the night without any attenion whatever. Many of the pumps on the

Northern company's lines were run for several weeks without stopping.

The cost of maintenance is also negligible. So far as is known at this time there were no repairs whatever required upon any of the pumping plants on these lines with the sole exception of one motor and compensator that were burned out through carelessness. A Greek laborer who had seen others start the pump, but who had no authority whatever to touch

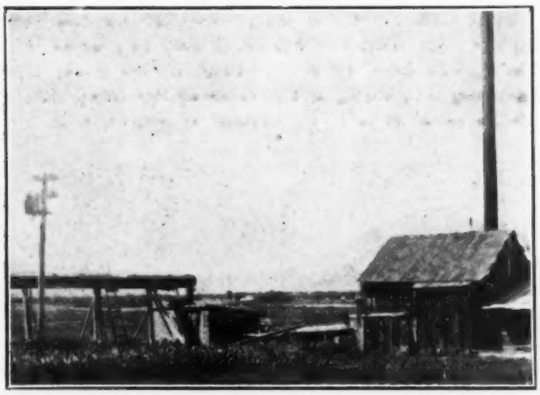


Fig. 7—Steam Pumping Station Replaced by Electric Plant.

it himself, thought he would like to see it run, and pulled the compensator in the starting position. He evidently became scared then, for he left it in that position and the motor and compensator were both burned out without blowing the fuses, which were in series with the running connections of the compensator. Each owner is thoroughly instructed in the operation of his plant before it is turned over to him, and when fuses are blown out they usually notify the company to replace them. There were many severe lightning storms during 1909 but none of the pumping plants was damaged or suffered losses other than blown fuses and cut outs.

Most of the plants are installed in first-class fashion. The buildings covering them are of small size, and are made of brick, concrete or concrete blocks. The pumps are nearly always set upon concrete foundations, and the water is brought close to the pumps in trenches having concrete sides and bottoms. The whole tendency is toward permanency. The pipe lines are usually made of steel, riveted and dipped in a hydrocarbon compound to prevent rusting. The pipes are usually

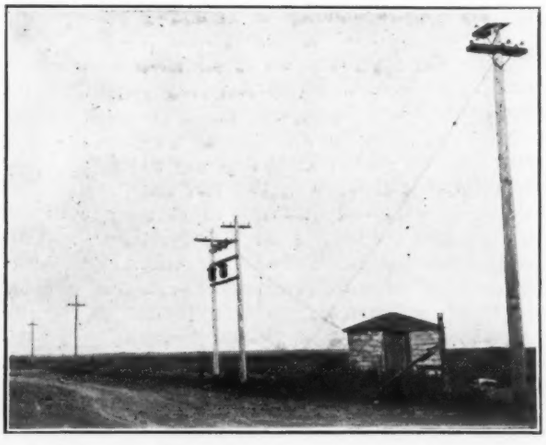


Fig. 8—Pumping Plant, Showing Transformers, Fuses and Lines.

laid in trenches about 30 in. deep, and the ground is tilled over them. The deterioration of the pipes is supposed to be slight. Brief descriptions of a few of the plants in operation around Eaton are appended.

An 8-in. pump is direct coupled to a 20-hp, 900-r.p.m., three-phase, 220-volt motor at the plant of E. L. Hensley. The capacity of the pump is 1600 gal. per minute delivered to a height of 25 ft. and discharged through 2000 ft. of steel pipe 15 in. in diameter, making a total head, including friction, of 30 ft. Three 7.5-kw, 6600 to 220-volt transformers are used. Water is pumped from a well that is filled partly from the underflow but principally from an irrigating ditch. The total cost of pumping in 1909 was $375 for 210 acres, or about $1.80 per acre.

The A. J. Eaton plants were installed in 1908. The larger contains a 5-in. and an 8-in. pump direct connected to 10 and 15-hp, 220-volt motors running at 900 and 720 r.p.m. The pump capacities are respectively 650 and 1300 gal. per minute delivered to a height of 26 ft. including friction in the tiling pipe. In the smaller plant is a 5-in. pump and 10-hp motor delivering water to a height of 16 ft. Three 10-kw transformers are used for the larger plant, and three 4-kw transformers for the smaller plant, all reducing the potential from 6600 to 220 volts. Water is secured from irrigating ditches and pumped to higher levels. It is interesting to note that nearly 25,000 bushels of potatoes were produced upon the 125 acres irrigated by the larger plant in 1908, the value of which exceeded several times the total cost of the pumping plant. This land had never been irrigated before.

Water in the E. K. Packard plant is secured from a lake and pumped to a height of 30 ft. through over 2000 ft. of 13-in. steel pipe. The pump is a 7-in. horizontal, direct coupled to a 15-hp, three-phase motor running at 900 r.p.m. There are three 5-kw 6600 to 220-volt transformers. In 1909, sufficient water was pumped for 100 acres of potatoes, 40 acres of sugar beets, and 30 acres of alfalfa at a cost for energy of $185.49. The motor consumed in a 12-hour test, 120 kw-hours of electric energy.

Water is secured from a seepage ditch which collects water from land soaked by too much irrigating in the plant of A. E. Montgomery. A 20-hp, 220-volt motor is direct connected to a 5-in. horizontal pump running at 1200 r.p.m., and delivers 650 gal. of water per minute to a height of 60 ft. or 1000 gal. per minute 48 ft. high, discharging it through 1380 ft. of pipe to the highest point. Three 7.5-kw 6600 to 220-volt transformers are used.

Water is secured in the W. P. Allen plant from an irrigating ditch and pumped for 120 acres of potatoes. The pump is a 7-in. horizontal machine with a capacity of 1180 gal. per minute and is coupled to a 25-hp, 900-r.p.m. motor. The pipe line is 1980 ft. long. Three 10-kw transformers are employed.

The C. S. Miner plant is situated upon the most remarkable well in northern Colorado. The well is 12 ft. in diameter and 28 ft. deep, the water standing 25 ft., or within 3 ft. of the surface. The pump is a 6-in. vertical machine and is suspended in a steel frame and hung so that it is nearly at the bottom of the well. Shafting is extended to the top and equipped with the belt pulley which is driven by a quarter-turn belt and a 15-hp 1200-r.p.m. motor. Two 10-kw transformers are used. It was thought the water would fall about 20 ft. when pumping was started, and the pump was speeded for a 30-ft. head, but the water never fell more than 10 ft. The pump, therefore, was operated at a speed much too great for a 20-ft. head, and the capacity of the pump reached 1800 gal. per minute, or double its normal capacity. The motor was overloaded and ran hot, but without serious effects. A larger pulley will be placed upon the pump shaft this year, and the speed of the pump reduced.

The few plants described here are typical of all, and show what marvelous progress has been made in a few years in the development of farm lands in Colorado. A few years ago cattle were running over these lands that now never sell for less than $100 per acre.

Whenever the pole lines run close to the farm houses small transformers are set and electricity furnished for lamps and motors. Many small motors are used to operate well pumps, some of which are equipped with automatic starters and float switches in the tanks. Alfalfa mills are being installed by many farmers and feed grinders by others, with motors to

operate them. The use of electricity for farm work has made great progress during the past three years, and is increasing rapidly. The Northern Colorado Power Company's generating station represents the pioneer American installation for the transmission of energy directly from the coal mines.

ICE-MAKING FROM EXHAUST STEAM.

Plant of the Holdrege, Neb., Lighting Company Which Makes Ice as a By-Product.

IN the spring of 1909 the Holdrege Lighting Company, of Holdrege, Neb., installed an ice plant of a manufacturing capacity of 10 tons of ice per day. This ice plant is of the ammonia-absorption type, which utilizes the exhaust steam from the engines of the electric plant. There is enough of this exhaust steam so that it is sufficient to supply all of the heat required for the operation of the absorption ice machine and for distilled water for ice-making, as described later.

THE ELECTRIC LIGHT PLANT.

Before going into the details of the ice-making auxiliary of this company an outline of the general conditions under which the electric plant operates will be given. The present management took hold of the plant in July, 1906. At that time there were only 100 electric consumers. A miscellaneous assortment of electrical apparatus was in operation, including alternators giving 60 cycles, 125 cycles and 133 cycles, single phase. Many of the line wires were of bare copper; the meters were of miscellaneous makes and were all out of order or plugged up. Breakdowns were of regular occurrence every Saturday night when the load was heaviest. The plant was on a small piece of ground, in the business district, not on the railroad. The only way out of the situation seemed to be to build an entirely new plant at a favorable location on a railroad siding. This was done.

The plant now consists of two 75-kw, three-phase, 60-cycle, 2300-volt alternators and one single-phase 50-kw alternator, making an aggregate capacity of 200 kw. One of the three-phase alternators is belted to a simple Ball engine and the other to a tandem-compound Ball engine. A view of the engine and generator-room is given in Fig. 1. The single-phase alternator is driven from a Russell simple engine. The building is of brick, with a flat roof. The cost of this building was about $4,500. The power plant occupies the flat-roof portion

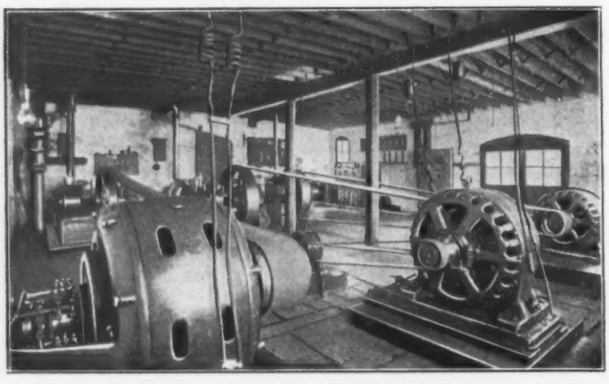


Fig. 1—Generating Room.

of the plant beyond the coal-storage bin at the right of Fig. 2. The stack is 4 ft. in diameter inside and 90 ft. high, of heavy steel construction, and was erected at a cost of about $1,500. There are two 72-in. x 16-ft. Murray horizontal return-flue boilers and two boiler-feed pumps. There are two deep wells, one with a Cook steam deep-well pump and the other electrically operated, as will be mentioned later.

There are now over 400 electric consumers. Sufficient motor and day load has been developed so that in August, 1909, during the day from 12 amp to 16 amp at 2300 volts were indicated, this being the month for which the tables given later apply.

One peculiar feature in the development of this business has been that the introduction of tungsten lamps has decreased the maximum lighting demand and at the same time, by virtue of a greater number of hours' use and an increase in motor load, has increased the kw-hour output. In other words, the load factor has been increased. The monthly load factor for August, 1908, taken from Table I, is 26.7 per cent and for August, 1909, is 34.4 per cent. This, too, has taken place in spite of the fact that in August, 1908, the stores closed at 7:30 p. m., while in August, 1909 they closed at 6 p. m. every day except Saturday. The horse-power in motors connected in August, 1909, was 59.

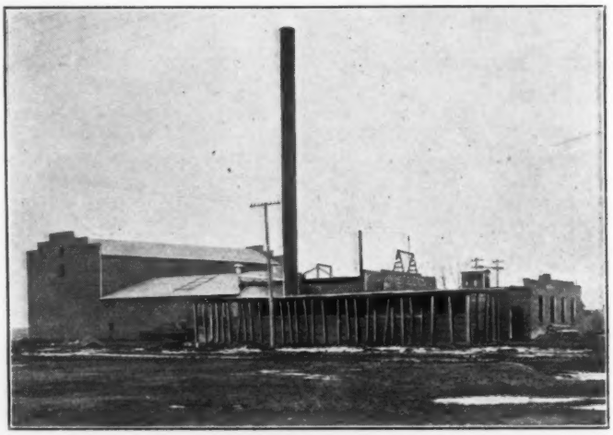


Fig. 2—General View of Electric and Ice Plant.

The employees of the plant for both electric and ice manufacture were as follows: Engineers and firemen, three; icemen, two; lineman, one; superintendent, one; manager, one; total, nine.

THE ICE PLANT.

The ice plant adjoins the electric plant and the ammonia-absorption machine is contained in the boiler-room of the electric plant. In Fig. 2 the two-story portion of the building at the left is a cold-storage house. Between the cold storage and the boiler-room of the electric plant is the tank room of the ice factory, which has a sloping roof. In Fig. 3 is shown a plan of the tank room of the ice plant and the boiler room of the electric plant, which contains the ice-making machinery. This gives a good idea of the amount of room taken up by the ice machinery. The space occupied by the boiler room is about 9 ft. x 30 ft., the ice-making apparatus being placed alongside of one boiler. In Fig. 3 the engine room of the electric plant and the cold storage of the ice plant are not shown, as it shows the plant as it was before the ice storage was added.

The ice plant is of the absorption type and was furnished by the Carbondale Machine Company, of Carbondale, Pa. Very complete records are kept of the daily operations by the company, and Table I gives the records for August, 1909, when the ice plant was in operation, as compared to August, 1908, before the ice plant was installed. This gives the pounds of coal per kw-hour under both conditions; output in kw-hours; pounds of ice manufactured; maximum and minimum back pressure on the engines, and the maximum demand on the electric plant for each day of the month, as well as the total output and coal used for the month. From this it will be seen that there is very little difference in coal consumption per kw-hour with and without the ice factory running, the average being 13.5 lb. for August, 1909, and 13.6 for August, 1908. However, the fact must be recognized that the output of the electric plant was greater in 1909 than the year previous and hence the coal per kw-hour in 1908 would naturally have been lower in any event. The low tonnage of the ice manufactured Aug. 5 and 9, 1909, was due to the fact that the small storage house

was so full that it was necessary to diminish the manufacture of ice until storage room could be provided.

In Februray the plant averaged 10.5 tons of ice manufactured per day, in addition to refrigerating the cold storage house.

Of the ice output of the plant for August, 1909, 354,000 lb. were sold in Holdrege. The rest of the output was sold out of town. All of the ice manufactured is sold at wholesale at a rate of from $3.50 to $3.75 per ton. Ice retails in Holdrege at 50 cents per 100 lb., or $10 per ton. In neighboring towns

TABLE I.—COMPARATIVE LOG SHEETS OF HOLDREGE STATION.

Pounds coal per kw. 1909.	Pounds coal per kw. 1908.	Output in kw. 1909.	Output in kw. 1908.	Pounds ice manufactured. 1909.	Back pressure, pounds, Max. 1909.	Back pressure, pounds, Min. 1909.	2300 volts demand, amp. 1909.	2300 volts demand, amp. 1908.	Date, Aug.
15.85	14.99	630	560	20,100	4	2	29	37	1
14.48	14.22	780	470	17,100	4	2	33	25	2
13.41	13.26	820	560	21,600	5	2	32	31	3
13.20	14.33	830	580	16,200	4	2.5	34	30	4
12.97	12.14	740	510	7,500	4	2	30	32	5
13.54	13.98	790	560	18,300	4	2.5	33	32	6
14.77	14.18	900	580	21,600	4	2.5	38	33	7
15.49	11.83	630	560	21,600	4.5	2.5	27	38	8
15.41	17.86	720	460	9,000	4	2.5	30	24	9
14.87	12.95	800	570	17,100	4	3	32	32	10
12.91	14.02	790	590	21,600	4	3	32	34	11
12.00	14.31	900	550	12,600	6	2	37	34	12
13.95	13.98	810	550	21,600	4	3	32	33	13
13.58	13.9	940	590	19,800	4	3	44	35	14
15.91	11.7	650	620	18,000	4	2.5	30	40	15
13.12	14.56	800	510	21,600	5.5	3	33	27	16
12.87	14.03	870	580	16,500	4	3	34	32	17
12.87	13.46	870	620	18,000	4	2.5	34	34	18
14.61	13.80	780	570	21,600	4	3	32	35	19
12.71	13.46	810	590	21,600	4	3	33	35	20
11.82	13.45	880	570	21,600	4	3	41	34	21
12.68	13.71	670	660	20,100	4	3	30	34	22
12.62	13.92	800	440	18,600	4	3	32	30	23
12.26	16.74	840	580	20,100	4	3	33	34	24
12.31	13.70	920	590	21,600	4	3	35	34	25
13.80	13.60	820	580	18,000	4	3	35	35	26
12.53	12.66	830	560	20,100	4	3	36	34	27
14.72	12.06	890	610	18,300	4	3	40	35	28
12.17	10.43	690	610	21,600	4	2.5	29	40	29
13.04	11.81	790	470	18,900	4	3	33	28	30
12.17	12.15	830	610	21,600	4	3	32	37	31
13.5	13.6	24,820	17,460	583,500					

where Holdrege ice is sold the retail price is 60 cents to 75 cents per 100 lb.

The only actual additional labor employed as the result of the addition of the ice plant is one man per shift; that is, two on the payroll. The principal duties of this man are pulling ice from the tanks as fast as cakes are frozen. The engineers of the electric plant look after the absorption ice machinery along with their other duties. Of course, the introduction of the ice business throws some additional work on the office force, but

TABLE II.—ENERGY USED BY PUMPS PER TON OF ICE.

Date, August, 1909.	Kw-hours per ton of ice for pumps, etc.
1	14.92
2	17.54
3	13.78
4	18.39
5	* 33.07
6	15.08
7	13.70
8	13.80
9	† 23.77
10	15.44
11	13.33
12	21.91
13	13.61
14	15.25
15	17.11
16	14.26
17	19.39
18	17.77
19	15.09
20	15.46
21	15.37
22	15.43
23	16.88
24	15.82
25	14.44
26	16.77
27	15.72
28	17.59
29	15.18
30	16.51
31	14.44

* Shut down part of time. † No deep well pumping.

the latter was not increased as a result of the addition of the ice plant.

Besides the additional labor required for the ice plant the ice plant is chargeable with the electrical energy used for operating the pumps required for ice manufacture. Watt-hour meters measure the energy so supplied and the kw-hours required per ton of ice manufactured are shown in Table II.

About 70,000 gal. of water per day is said to be required for cooling water in connection with the ice plant and for boiler-feed purposes, but more is used. The deep-well pump, 6 in. in diameter by 24-in. stroke, running 27 r.p.m., driven by a motor, supplies the cooling water. This same motor also operates a distilled-water pump for raising the condensed water from the receiver to the reboiler, and also the brine and liquid ammonia pumps. The back pressure at the altitude of Holdrege is somewhat higher than would be necessary at sea level on account of the lower boiling point of water at Holdrege.

Fig. 3 shows the ice-plant addition to the electric plant, 25 ft. 6 in. x 41 ft., as it existed in August, 1909, the month for which these records are given. This addition contains the tank room, Fig. 7, in which the cold brine is circulated around the cans in which the cakes of ice are frozen. Adjoining the tank room is a temporary ice storage, where ice is placed after it has been harvested and before it is called for. Since that time the large cold-storage building, seen in Figs. 2 and 9, has been erected at a cost of about $15,000.

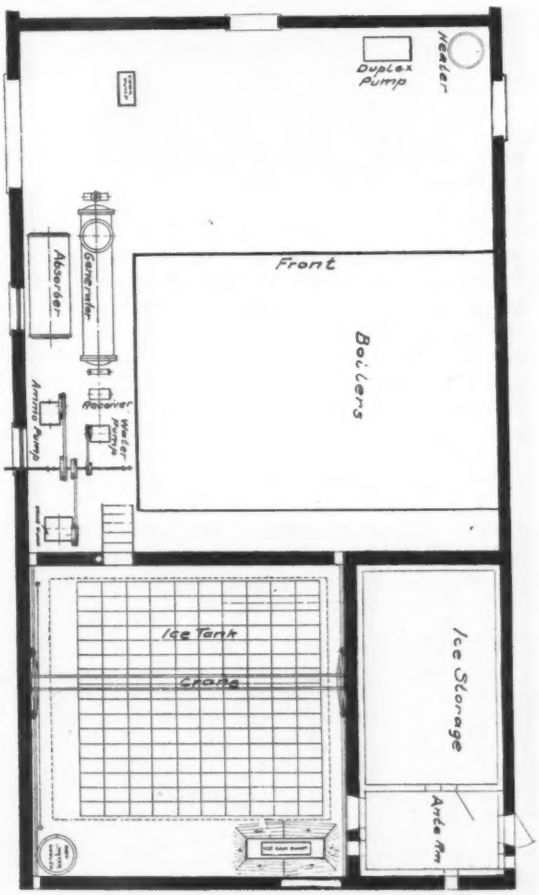


Fig. 3—Plan of Ice Plant and Boiler Room.

There are some interesting features in ice-plant economies in connection with this plant that differ from those in the majority of ice plants which are not operated as an auxiliary to an electric plant. In the ordinary compression ice plant operated independently of any other industry, it is not usually considered economical to build a cold-storage house for the purpose of storing ice during the winter time for sale in the summer. This is exactly what has been done in Holdrege, however, and it is justified by the conditions there, although it probably would not be justified under conditions obtaining in an independent compression plant. It may be stated, roughly, than an independent compression-type ice plant costs approximately $1,000 per ton of daily ice-making capacity. That is, an inexpensive type of 15-ton plant would cost, with building and land, $15,000. By

building an ice storage in connection with such a plant ice could be stored during the winter for sale in summer, but the interest on the added investment in ice storage plus the high cost of operating the ice plant the year round and maintaining refrigeration of the cold-storage room to prevent the melting of the ice stored, makes it cheaper to put in additional ice-making capacity for service during the summer months rather than build and maintain a cold-storage building.

At Holdrege conditions are radically different from what they would be in an independent ice plant. In the first place, the exhaust steam from the electric plant is available every day in the year, and if it is not utilized in ice manufacture or refrigeration it simply goes to waste. If it can be utilized during the cold weather to make and store ice for the peak-load ice demand of the summer, the income of the plant is considerably increased. The operating cost per ton of ice will, therefore, be less than that of maintaining an independent plant during the winter months. Another condition at Holdrege which made it desirable to install storage rather than additional ice-making capacity is the fact that ammonia-absorption apparatus costs more per daily ton of capacity than compression apparatus, and, therefore, the additional daily ice-making capacity would represent a larger investment than in the case of the compression machines. Furthermore, the amount of exhaust steam available for condensation into distilled water might not be sufficient to make a great increase in the amount of ice manufactured.

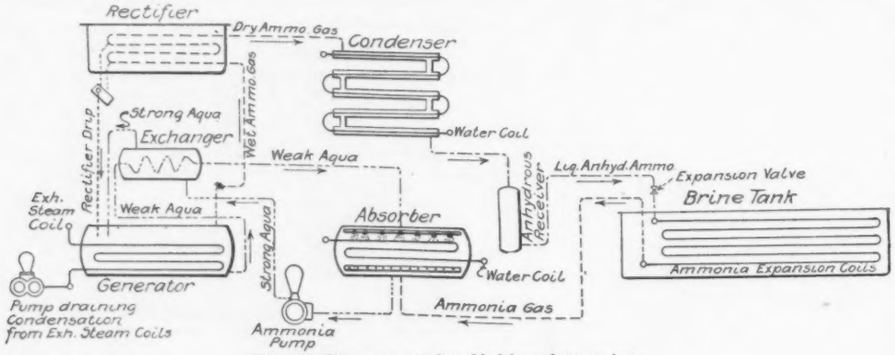


Fig. 4—Diagram of Ice-Making Apparatus.

To come to specific figures, the investment in the ice plant as it stood in the summer of 1909, with a rated capacity of 10 tons daily, was approximately $18,000. However, all of this is not chargeable to the inherent difference in cost between the ammonia-absorption system and the compression system. The construction used in Holdrege is all of a first-class, substantial character and should not be compared with some of the temporary shacks which house some ice plants. The buildings are all of brick and heavy insulation has been placed in all the walls.

The new cold-storage building has a capacity of 2000 tons of ice. It is, therefore, capable of taking the full output of a 10-ton plant for 200 days out of every year. It is estimated that the refrigeration of this cold-storage building in the summer will reduce the ice-making capacity of the plant from 1.25 tons to 1.5 tons. Now this ice-storage plant costing $15,000 when added to the $18,000 before invested in the ice-making machinery make a total investment of $33,000. Assuming that most of the ice demand is confined to 100 days out of every year, the 2000 tons of ice stored in the storage building will enable the plant to deliver to its consumers 20 tons per day out of storage, in addition to the 8.5 tons direct from its tanks. In other words, for all practical purposes the Holdrege Lighting Company will have the coming season an ice plant of 28.5 tons capacity per day. The investment of $33,000 in ice plant and storage will be no more than the investment necessary to put in a 28.5-ton ice-making plant, to say nothing of the fact that an ice-making plant of such size could not be operated with the amount of exhaust steam likely to be available. It will be seen, furthermore, that the investment per ton of ice which can be delivered per season is not at all excessive. After all, it is the tons of ice per season which determine the income of the plant, providing the ice can be delivered at the exact time when there is a demand for it.

Carrying out further the assumptions that the plant will be operated 300 days per year, 200 days of which are mainly taken up in storing ice, 100 days in drawing ice out of storage and direct from the tanks, and two months for any overhauling for repairs necessary, the yearly capacity of the plant will then be as follows: 100 days' manufacturing capacity at 8.5 tons per day, 850 tons; ice drawn from storage, 2000 tons; total season's capacity, 2850 tons. If all this can be sold at a price of $3.50 per ton the income from the ice plant will be $9,975, yielding a gross return on the investment of 32 per cent. The exact expenses of conducting this business will be difficult to determine. The largest item of operating expense is the wages of the two men to handle the ice. A portion of the general expenses of the company, which is management, bookkeeping and like expenses, should be charged to this part of the plant. To the operating expenses, the fixed charges of interest and de-

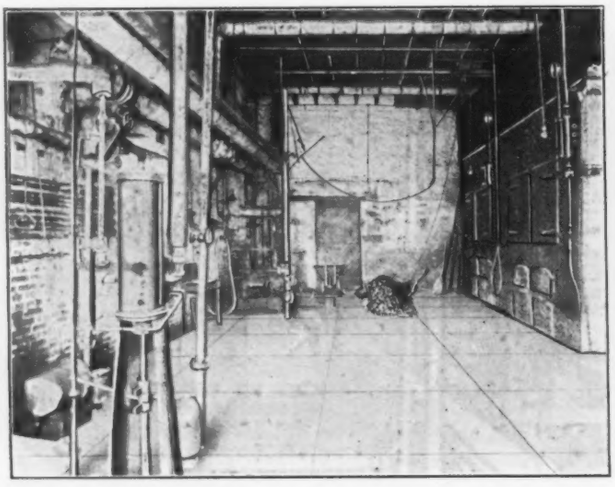


Fig. 5—Boiler Room.

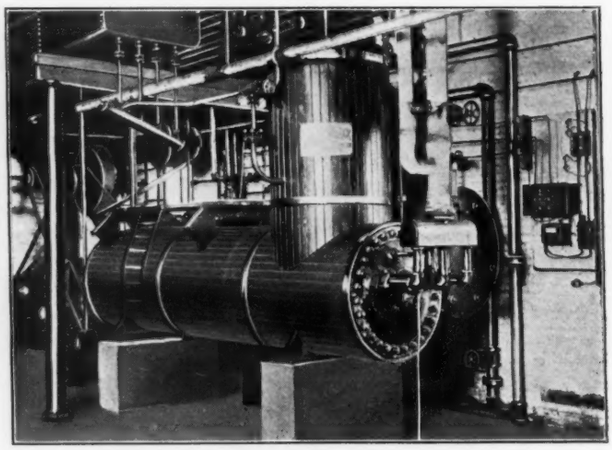


Fig. 6—Ammonia Boiler.

preciation should be added. These fixed charges are doubtless larger than the operating expenses.

For the benefit of engineers and central-station managers who may not be familiar with absorption ice machinery (which is not by any means common), the following general description of the principles of operation of this apparatus may be of interest.

All ammonia refrigerating machines depend for their action on the expansion of ammonia gas through the refrigerating coil. In the compression machine a compressor for the ammonia is provided, which raises the gas to a sufficient pressure so that after the gas is cooled when allowed to expand the necessary cooling effect is obtained. In the absorption machine, the pressure of ammonia is obtained by applying heat to liquid aqua ammonia, which drives off the ammonia gas and produces ammonia gas under pressure just as in the compression machine. In the exhaust-steam ammonia-absorption machine the heat of the exhaust steam is used to boil the ammonia in the ammonia boiler or generator.

In Fig. 10 is shown a diagrammatic arrangement of an electric plant operating an exhaust-steam ammonia-absorption ice machine. In the engraving 1 is the boiler of the electric plant; 2 is the steam engine driving the electric generator; 3 is the feed-water heater in the exhaust of the steam engine; 4 is the regular exhaust head with a back pressure valve set to release at the desired pressure in case the back pressure on the engine becomes excessive; 5 is the oil separator. After passing the oil separator part of the steam enters the coil of the generator 6, which is the ammonia boiler. In the process of boiling the ammonia, the steam is condensed and runs into the receiver 7 below the ammonia boiler. The steam not needed by the ammonia boiler passes to condensing coil 9, where by means of cold water flowing over these condensing coils the steam is condensed and also is drained to the receiver 7. From the receiver 7 is taken the distilled water, which is used for ice manufacture. The pump 8 raises the distilled water from this receiver to a reboiler 10, for even after the water is distilled it is necessary to reboil it to drive out the gases which it has

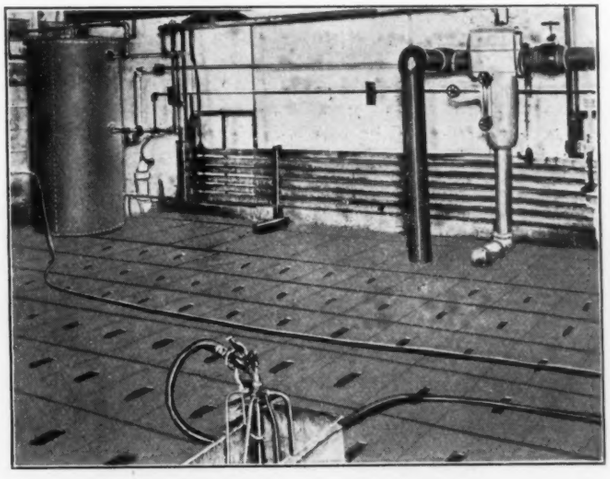


Fig. 7—Ice Tank Room.

absorbed during condensation. After reboiling the distilled water is used in the ice cans for making ice.

In Fig. 4 is shown, in diagram, the arrangement of a complete ammonia-absorption ice apparatus as installed at Holdrege. The ammonia generator consists simply of a horizontal tank with coils carrying the exhaust steam running through it, as seen at the left in Fig. 4. The heat of the exhaust steam boils the ammonia and drives off the ammonia gas, which passes to the wet gas rectifier. In the rectifier is simply a flat ammonia coil, through which the gas circulates, and around which water is kept at such a temperature that it will condense the steam or water vapor which may be in the ammonia gas without condensing the gas. The condensed steam runs back into the generator. From the rectifier the ammonia gas passes through the dry-gas condenser. Here the gas flows through coils around which, or in which, cold water is circulated to cool down the gas so as to liquify it. The heat which is taken away from the

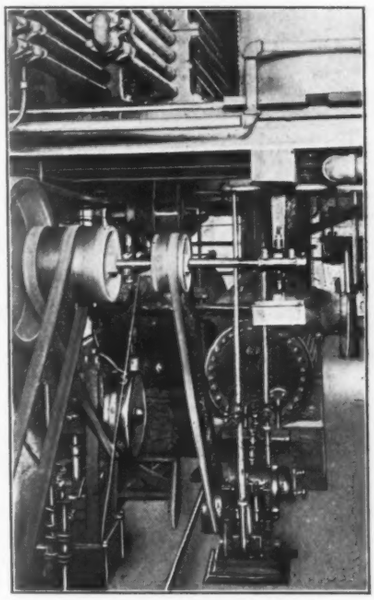


Fig. 8—Motor-Driven Pumps of Ice Machines.

gas in this process of condensation by the condensing water is reabsorbed as soon as the anhydrous ammonia liquid under pressure begins to expand in the refrigerating coil in the system. It is this reabsorbing of heat by the ammonia in the process of expansion that causes the refrigerating effect. The condensed ammonia flows down through a pipe into a receiver which receiver is provided with a gage glass to show the height of the condensed ammonia in the receiver. A feed line is taken off the bottom of this receiver and passes up to the expansion valve. The pressure in the system behind this valve is, of course, sufficient to keep a continuous stream of liquid ammonia flowing through it. After expanding at this

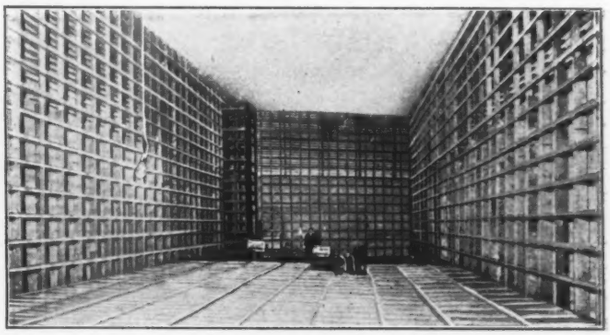


Fig. 9—Interior of Ice Storage House.

valve, the ammonia passes through the refrigerating coil. These coils are located in the brine cooler. Brine is circulated around these coils and is cooled by the absorption of heat from the brine by the ammonia which is expanding inside the coil. The brine is pumped to the tank room and circulated around the cans where the ice is frozen. After passing through the tank room is again brought back to the brine cooler. This circulation of brine is continuous while the plant is in operation.

The next process in the operation is to get the ammonia absorbed by the weak aqua liquor so that it can again be boiled in the generator and used to repeat the cycle. From the top of the brine cooler, the ammonia is piped to the bottom of the absorber. This weak liquor absorbs the ammonia gas. Cooling

coils in the absorber aid the process. In order to keep a supply of weak liquor in the absorber and also to create the necessary difference in pressure between the generator and absorber, an ammonia pump is used, which takes the strong liquor from the top of the absorber and delivers it to the top of the generator. From the bottom of the generator a hot weak liquor pipe is taken, which passes through the exchanger and back to the top of the absorber. The exchanger is comparable to the feedwater heater on a steam boiler. Its purpose is to exchange heat between the cold strong liquor which is being pumped to the

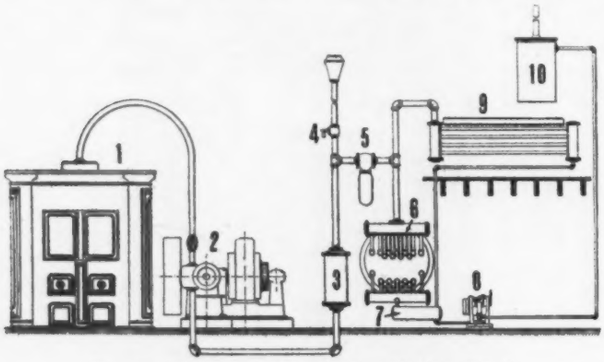


Fig. 10—Diagram of Electric Ice-Making Plant.

generator and the hot weak liquor which is being forced from the bottom of the generator back to the absorber. The hot weak liquor passing from the generator back to the absorber flows through the coils shown, and the cold strong liquor going from the ammonia pump to the generator passes around the coils in the shell of the exchanger. It will thus be seen that there is a continuous circulation of ammonia liquor from the absorber to the generator or boiler and back to the absorber; the weaker liquor in the generator being drawn off to pass back to the absorber, where it is again brought in contact with the ammonia gas coming from the brine cooler.

It is usually estimated that in a system of this kind the amount of cooling water required is about 4.5 gal. per minute for each daily ton of ice-making capacity. This is on the assumption that the cooling water enters the apparatus at a temperature of 60 deg. For a plant of 10 tons daily capacity, therefore, the amount of cooling water required would be 45 gal. per minute. If plenty of cooling water is available it is certainly desirable to use more, because it reduces the back pressure which must be carried on the exhaust of the engine in order to operate the ammonia boiler or generator. In the Holdrege plant, as can be seen by figuring the displacement of the deep-well pump supplying the plant, the amount of water used in the summer of 1909 was about 80 gal. per minute.

Fig. 6 is a reproduction of a photograph of the generator or ammonia boiler in the Holdrege plant. The boiler consists essentially of a shell in which the exhaust-steam pipes are mounted horizontally. The ammonia liquor surrounds these pipes in the shell. The whole device is thoroughly lagged to keep in the heat. Fig. 7 is a view in the ice tank room, showing the covers of the cans in which the ice cakes are frozen. The cold brine is circulated continuously around these cans to freeze the ice. Fig. 8 shows the short lineshaft, driven by an electric motor, which operates the ammonia pump, pumping ammonia liquor from the absorber into the generator, and also a small pump for raising the condensed water of the engine exhaust into the reboiler, where it is reboiled for use in ice-making.

Fig. 9 shows a view of the interior of the recently completed cold-storage plant, which has a capacity of 2000 tons of ice. Around the walls of the upper part of this plant can be seen the refrigerating pipes. Space is provided for the circulation of air around the packed ice between the ice and the walls of the cold-storage building.

The Holdrege Lighting Company is under the general management of Mr. L. J. Schwingel, with Mr. R. M. McCandlish as superintendent.

COMBINED INDUSTRIAL POWER AND TOWN LIGHTING PLANT.

It is generally recognized that unless a town is very prosperous or possesses a number of manufacturing establishments requiring electrical energy for their operation, an electric light station in such a place has a very precarious existence. It is not unusual therefore to find electric generating stations in a very many small towns operated in conjunction with some other industry. A station of this kind is found in North Manchester, Ind., a town having according to the latest census a population of 3500.

The first electric light plant in this town was established in 1888 by George Burdge. The unit, capable of supplying 100 incandescent lamps, was placed in a cooperage plant operated by Mills & Bonner. Soon afterwards another unit was added and the service was said to be very good; Bernstein incandescent lamps requiring from 5 to 10 amp being used at that time. The business having outgrown its old quarters, a plant was erected near the Wabash depot and the town contracting for 14 arc lamps, a low-tension arc machine of 20 amp rating was installed and operated up to one o'clock. The fuel available comprised refuse from heading and saw mills and the only expense attached to it was the cost of bringing it to the station. The net revenues of the station however were very meagre and the run for so small a number of arc lamps so long that the owner found it convenient to take a partner into the business.

Messrs. J. W. Boyer and J. A. Browne becoming owners, a new plant was erected in 1892 on a siding of the Big Four and Wabash railroads. A 150-hp engine, new boilers and a 50-light arc generator built by the Standard Electric Company were installed and what with 11 additional arc lamps on the streets and a saw mill in close proximity so that the fuel from the mill was conveyed by blower to a brick vault during the day, the station fared well. The cost of fuel was a minimum and stores and business places were induced to add to their lighting equipment. By this means and by practicing strict economy in the station, the plant managed to eke out an existence without anything to speak of in the way of profits.

In 1897 the plant was again remodeled. The old Indianapolis Jenney incandescent machines were replaced by a 60-kw alternator wound for 2300 volts and 133 cycles. The next year the station passed into the control of Messrs. J. A. Browne and Henry Mills and a combination with the present

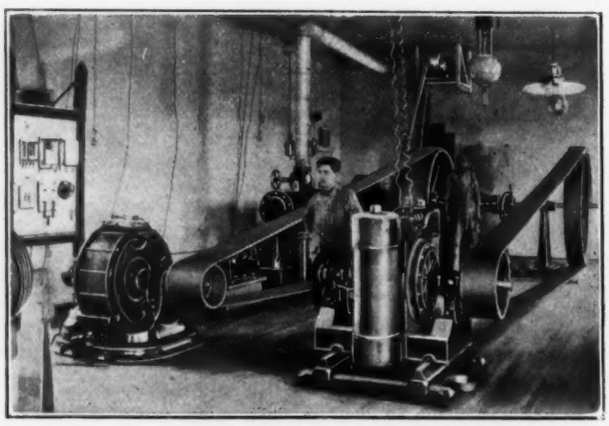


Fig. 1—Original Plant of the Browne-Mills Electric Company.

manufacturing plant of J. A. Browne & Company perfected. A view of the station of the Browne-Mills Electric Company at that time is given in Fig. 1 herewith. The equipment consisted of a 50-light, open arc machine built by the Standard Electric Company of Chicago and a 60-kw, 133-cycle, 2300-volt, single-phase alternator made by the same company. These were belted to a Russell engine. The alternator was of the revolving field type and although quite efficient was also very

noisy in operation. On the extreme left of the illustration may be seen a portion of an extra armature—a necessary adjunct to continuous operation at that time. The armature of the arc machine was Gramme wound and a coil or section was expected to burn out once a month; so to provide for such emergencies an extra armature was always kept on hand.

It was about this time that it occurred to Mr. Browne that a consolidation of the lighting plant and the wood-working

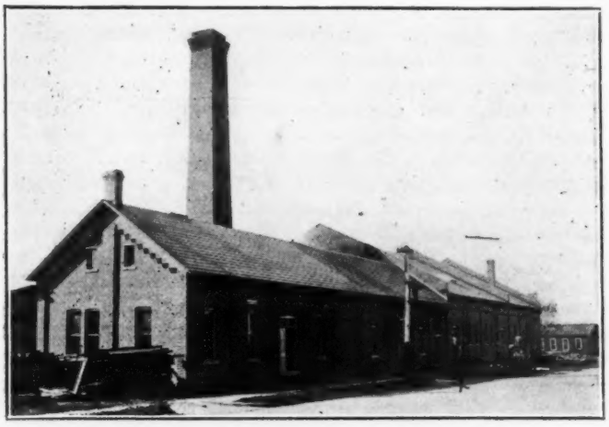


Fig. 2—Exterior of Browne-Mills Electric Company's Station.

establishment would prove advantageous. The factory produced large quantities of wagon and carriage woodwork in the white, and had sufficient waste at all times to provide fuel for the boilers. An addition was therefore added to accommodate engines and dynamos and another addition was erected for a workshop and for housing electrical supplies. The old plant was then abandoned, the premises sold, and in six years a saving of $6,000 was made by combining the two plants, in addition to gains estimated by combining the operations of two separate establishments.

From its inception this scheme of concentration proved a success, both from a standpoint of economy of fuel and a saving in labor as well as insurance, taxes and administration expense. It was found that the factory night watch was available for duty as a helper, thus insuring better efficiency as a watchman than before. The boilers were always ready at lighting time and further, the boilers being kept at the

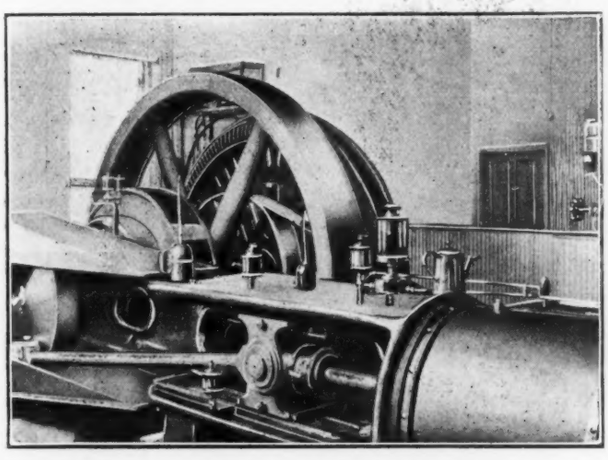


Fig. 3—125 Kw Direct-Connected Unit.

same temperature with steam up, repairs were less since the replacement of tubes due to expansion and contraction where boilers are allowed to cool off each day, did not obtain. The boilers are arranged so as to receive a constant stream of shavings, sawdust, etc., by means of a blower cyclone system and a cable conveyor from the factory discharges all waste wood suitable for fuel in a brick vault immediately in front of the furnaces.

When the combination was effected and after eight more arc lamps were added and all night service inaugurated, the prospects of profits looked brighter; but the old Gramme wound arc machine was a constant trouble maker. North Manchester was and is now splendidly equipped with shade trees and the owners of the trees forbidding trimming, grounds were frequent and the extra armature was pressed into service so often that operation became a burden. In 1903, a 120-kw Westinghouse alternator was installed together with a Western Electric series enclosed arc system and the old arc plant was sold for junk. The new system proved a success and the street lighting service was more satisfactory than ever before. The high-speed engines however were a source of waste and an Allis-Chalmers Corliss engine displaced the two engines previously used, and heaters of an improved type with hot water pumps were installed, enabling a better showing to be made.

The 120-kw unit with the help of the 60-kw unit was found to be too small and again the work of dismantling and replacing took place in May, 1909. A heavy duty, Allis-Chalmers Corliss engine direct-connected to a 300-kw, three-phase, 60-cycle, 2000-volt alternator was installed and placed in operation on June 1. Thirteen motors aggregating 120 hp were also placed in operation in the wood-working factory and a day service instituted. The unit was found to be too large however after peak loads were off and a smaller unit could carry the load from eight or nine o'clock to seven o'clock the next morning. In November, a Fitchburg engine direct-connected to a 125-kw, Ft. Wayne three-phase, 60-cycle, 2000-volt alternator was purchased and placed in operation for this purpose.

The thirteen motors installed in the manufacturing department insured increased economy over the previous system of line shaft and belt transmission and at times when work was pressing double the output of the factory was secured and wood-working operations carried on through the night. There are also in operation outside of the company's factory eleven other motors and two mercury arc rectifiers. For the purpose of maintaining a constant voltage on its circuits at all times, the company is about to install a Tirrill regulator. In a wood-working establishment there are necessarily large quantities of dust, and for the purpose of keeping the motors and generators free from deposits of this kind an air compressor is installed.

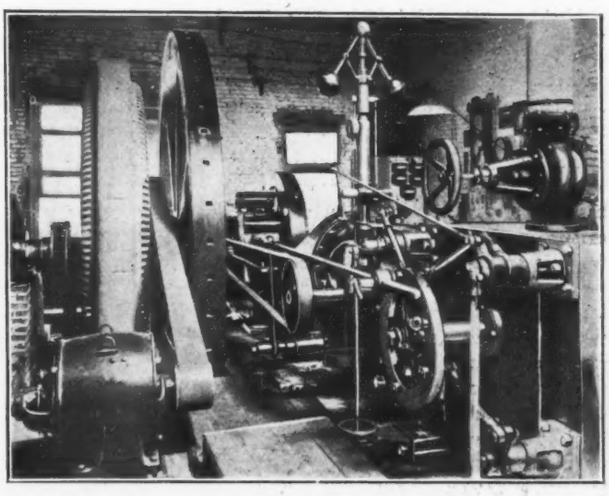


Fig. 4—300-Kw Corliss Engine-Driven Alternator and Exciter.

The Commercial and Industrial Association of North Manchester has not been slow in grasping the opportunity afforded by a 24-hour electric service, to advertise and boom the town; since with good transportation and cheap power, a nucleus for a growing city is provided. The rates for electrical energy are made in accordance with a schedule for cities of 25,000 inhabitants and since the institution of a day service the income has increased perceptibly.

HYDROELECTRIC ENERGY FOR FARMERS.

Low-Head Plant in Indiana for the Supply of Electricity in a Rural Community.

A LOW-HEAD water-power development on the Elkhart River, in Kosciusko County, Indiana, supplies electrical energy to the neighboring towns of Syracuse and Milford, besides furnishing several farms along the transmission line with 24-hour service equivalent in quality to that enjoyed by many urban communities. Cheap electricity is supplied for the operation of the farmers' feed choppers, grinders, shredders, bottle-washers, churns, cream separators, pumps, etc., as well as for lighting, while one progressive stock-raiser even heats the water supplied to his tanks for watering stock—animals, not securities—by electrical means.

Fig. 1—Elkhart River Near the Diverting Dam.

The history of the various efforts to supply hydroelectric energy to Syracuse has been characterized by some discouragements and difficulties. In 1903 the present plant was erected by the Syracuse Power, Light & Manufacturing Company, a corporation of local capitalists who purchased the Boyd water rights on the Elkhart River. After several years of operation the plant seemed to be insufficient and the service became inadequate; local apathy and indifference to electric lighting developed; the plant was allowed to run down, and early last year the affairs of the company were placed in the hands of a receiver. The present Syracuse Power & Light Company was then incorporated with a capital stock of $30,000, new business policies were inaugurated, and the equipment restored and improved, with the result that the plant now seems fairly started as a dividend payer. The advent of the tungsten lamp, which has virtually more than doubled the lighting capacity of the existing generating equipment, is given a large share of credit for this successful rehabilitation.

The water-power generating station utilizes a 10-ft. drop in the Elkhart River at a point six miles north of Syracuse. Here a 30-in. wooden dam deflects about 10,000 cu. ft. per minute of the river's 20,000-cu. ft. flow (yearly minimum) into a raceway which parallels the bank for three-quarters of a mile. At the lower end of this race a concrete water-wheel setting, 25 ft. x 35 ft., capped by a wooden shed, houses two 100-hp "Little Giant" vertical water turbines, controlled by a mechanical governing device. These water-wheels operate at 117 r.p.m., and are bevel-geared to the horizontal shaft, from which a 15-in. belt drives the 100-kw, 2300-volt, three-phase, 60-cycle General Electric self-exciting alternator at 900 r.p.m. The station transformers step the output of this machine up to 6600 volts for the six-mile transmission into Syracuse and the further extension of five miles to Milford. At both destinations transformer substations lower to the distribution pressure of 2300 volts for lighting, and constant-current regulator sets provide a suitable supply for the series alternating-current street arcs. The various station panels are provided with oil switches, fuses, ammeters, voltmeters, etc., and lightning arresters are applied at each terminus of the line.

The present peak load of 90 kw to the lighting demand, occurs about 8:30 p. m. Energy for operating 50 hp of motors in the local flour mill and radiator-factory machine shop is supplied with the understanding that these machines will not be used between 6 and 9:15 p. m. It is obvious, considering the capacity of the generating equipment and the lighting and motor load fed from it, that some sort of provision of this kind is necessary. Otherwise the character of the electric service would be very much disrupted. This is the rock on which many small companies founder. The peak load is so heavy and lasts for so short a time that the investment necessary to carry it is out of all proportion to the income derived from it. The 30-hp motor in the flouring mill, which is also owned by the Syracuse Power & Light Company, provides the entire motive power for the grinding and refining processes. By the use of electrical energy it has thus been possible virtually to pick up the mill from the secluded water-power site and to set it down beside a railroad switch in the center of a busy community, relieving the old-time process of "going to mill" of much of its delay and difficulty. There are now seven motors connected in Syracuse, of from 2 hp to 30 hp capacity. For their use a "power" rate of 3 cents per kw-hour is made, with a minimum charge of $1 per horsepower per month. The average daylight load on the generator is at this time about 60 electrical hp.

With its population of 1400 Syracuse has 175 electrical consumers entered on the lighting company's books, about half of whom are supplied on a meter basis. The use of meters is advocated, and is insisted upon in cases where the customer has been discovered abusing his flat-rate privileges. The company sells meters to its customers at the current market price, or will lease the instruments at a monthly rental of 25 cents. Here, again, a small company is brought face to face with certain economic conditions. The installation and care of meters calls for a certain expenditure of money, not to mention the extra work involved in reading them and in keeping books, making out and delivering bills, etc. No hard-and-fast rule can be laid down when and when not to meter energy. In a system such as that in vogue at Syracuse, the rental of meters

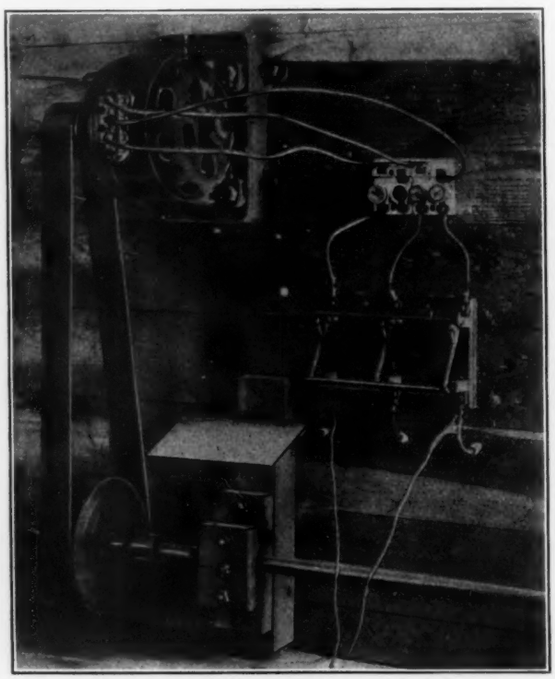


Fig. 2—Motor for Driving Bottle Washer, Churn, Cream Separator and Milk Cooler.

safeguards the company against loss due to extra financial burden involved in the outlay for meters. At its flat-rate schedule the company supplies electrical energy to three 16-cp carbon-filament lamps for $1.10 per month, with a charge of 30 cents for each additional lamp. In the case of tungsten lamps this rate is modified to 1 cent per watt per month, thus making the cost of operating a 40-watt lamp 40 cents per month. The 40-watt tungsten is strongly advocated by the lighting company officials, who admit that the reduced energy consumption of this illuminant has practically saved the day for their water-power plant, enabling it to supply an increasing lighting load which otherwise would have taxed the power capacity of the stream long ago.

It will be noted that no reserve capacity has been provided for in this development, only the normal flow of the stream being available to meet peak loads as the plant is now arranged. However, the franchise permits crest-blocks to be added to the diverting dam to a height of 12 in. in case of low water, and experiment has shown that the first 6 in. will impound sufficient water to carry the peak load for three hours.

Some time ago a 75-hp single-cylinder gasoline engine was installed in the water-power plant to aid in carrying the heavier loads and to act as a reserve in case of failure of the water supply. This engine was coupled to the water-wheel shaft, but a month's operation showed that the unequal impulses of the engine and steady torque moment of the turbines could not be reconciled. Much noise and difficulty resulted, and the engine was taken out. Therefore, the town now depends solely upon water-power for its lighting and power.

The streets of Syracuse are lighted by 30 6.6-amp, 1200-cp series alternating-current arc lamps supplied from a constant-current transformer, while Milford is similarly served by 20 lamps of the same type. These lamps are operated on the "moonlight" schedule" and cost the town $55 per year each, including trimming, attendance and repairs.

The Syracuse lighting company has found the farmer a valuable customer, and makes every effort to obtain new consumers in the country adjacent to its transmission lines. In these cases the customer pays for the construction of a 6600-volt pole line from the company's lines to his own yard, where a step-down transformer is installed, reducing to 110 volts or 220 volts for use in the farmhouse and buildings. The same rates are charged as in the town. For lighting service only one phase is brought in; if motors are to be operated a three-phase installation is completed.

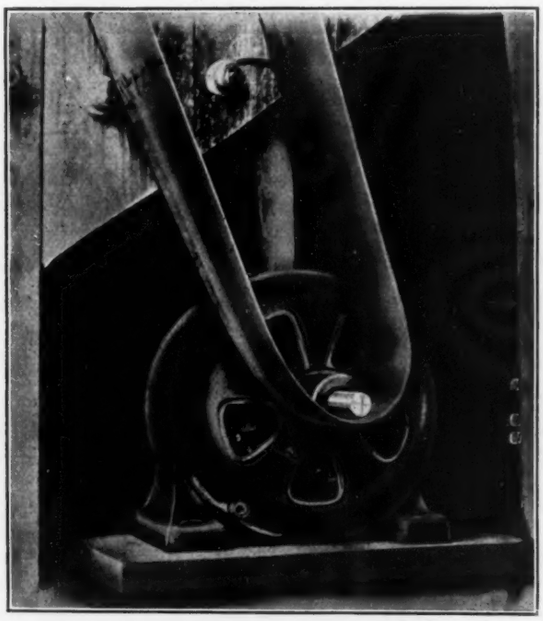


Fig. 3—Motor for Driving Feed Chopper, Corn Husker, etc.

One of the most progressive farmers in Indiana is Mr. John A. Neff, of Kosciusko County, who has a very complete electrical equipment in his barn and house. One-half mile of pole line and a 5-kw, three-phase transformer cost him $368 to install. In his barn a 2-hp, three-phase motor is belt-connected to an overhead lineshaft, from which are driven a 20-bu. Bowsher feed grinder, a Plano corn shredder and husker having a capacity of 20 bu. per hour, and a Bowsher feed chopper. In this section of the country a man can be hired to husk corn for about 3 cents a bushel or $1 a day and board. The motor-driven machine, however, will do the work of three men, husking out and shredding 200 bu. in a 10-hour day at an expenditure for 14 kw-hours, besides delivering the corn to the bin and the shredded fodder to the haymow without further attention from the operator. The motor-driven grinder and crusher in the barn performs for 1 cent per bushel the same service for which 5 cents would be charged at the mill, besides avoiding the time and expense of hauling both ways.

In his dairy barn Mr. Neff has installed a 1-hp motor which drives a bottle washer, churn, De Laval cream separator and a pump delivering water to a 20-gal. milk cooler. The milkman rises early, milks by the light of the electric lamp, and puts the milk away to cool in the apparatus mentioned. This extracts the heat and certain animal tastes from the milk. The warmed water from the circulating coils is delivered into the stock tank. In severe weather this water is arranged to be further heated by an electrical resistance coil supplied from the transformer secondaries. This heater takes 350 watts, and during the present winter is placed in the trough about the farmer's bedtime, 9:30 p. m., and taken out in the morning when he gets up at 4 o'clock. The water is thus prevented from freezing and the cows are supplied with a warm summer drink. From Mr. Neff's transformer ½ mile of 220-volt pole line supplies lighting energy to his nephew's farm residence.

The farmer, as a class, is a good electrical customer, the local officials report. He likes plenty of light in his house; his peak demand comes early; he usually burns a lamp or two all night as a matter of protection, and when he can be induced to become a consumer of electrical energy for motor purposes he provides a profitable day load for the central station. Furthermore, the electric service has proved profitable to those farmers around Syracuse who have used it. Their success with the new motive power has compelled the interest of others, and the company is now sanguine of connecting up every possible consumer within a mile of its transmission line. As the development hoped for takes place, branch lines will be run to local distribution centers from which it will be possible to serve a group of neighboring farms.

This farm service is an attractive field for the Syracuse company, which has already nearly reached the limit of its evening peak lighting load, but it anxious to improve its load factor by developing the output at other hours. With its water-power plant operating without storage capacity, such off-peak consumption is particularly profitable, entailing no increase in the plant operating costs. As the region is largely agricultural—the farmers representing the chief producing activities—the power solicitor's attention has naturally been turned to this rather unusual field when seeking an industrial load.

Besides the officials, three men are employed to operate the plant—a superintendent, who looks after making connections and installations, and remains on hand in Syracuse in case of trouble with the lines or service, and two operators at the water-power generating station, who take, respectively, the day and night shifts. The secretary-treasurer of the company solicits new business, reads meters and collects bills. The officials assert that at the present time this 100-kw, low-head water-power plant is developing electrical energy at an average cost of less than 2 cents per kw-hour, including all items of interest, salaries, supplies and depreciation of the equipment.

The officers of the Syracuse Power & Light Company are: President, Mr. J. P. Dolan; vice-president, Mr. H. D. Boozer; secretary-treasurer, Mr. C. C. Crow; superintendent, Mr. W. E. Binkley.

ECONOMIES OF A SMALL CENTRAL STATION.

Development of the Business of the Gardner, Mass., Electric Light Company.

An interesting example of progressive central-station development within the past five years is afforded by the work of the Gardner Electric Light Company, of Gardner, Mass. Although the system is one of very moderate size, serving a community of about 12,000 inhabitants, both the engineering and commercial sides of the business furnish instructive illustrations of recent tendencies in the production and sale of electric energy. The plant began operation about 20 years ago with a belted steam-engine installation; later it installed oil engines, with a marked increase in economy, and lately a further radical change in policy has been inaugurated by the establishment of a receiving station, at the side of the old plant, in which energy taken from the 66,000-volt transmission line of the Connecticut River Transmission Company is transformed to 2300 volts for local distribution, leaving the old installation as a reserve. The station equipment of the company thus illustrates a process of evolution from the fuel basis of coal to an oil-consuming plant, with a final conversion of the property into a hydroelectric substation. Each step has been taken in the direction of increased station economy, and the community has shared with the company the benefits of engineering progress.

On its commercial side the company has also accomplished noteworthy results, especially as regards motor load. About four years ago the rates for energy used in motors were practically cut in half, and the response of the community has been most interesting as evidence in support of low rates for this class of service. The company has not been slow to adopt the latest methods of interesting the public in what it has for sale, and by means of a well-equipped office in the business center of the town has done much to bring the latest methods of illumination and motor applications to the attention of the community.

Gardner is a town located in the northwest portion of Worcester County, on the Fitchburg Division of the Boston & Maine Railroad, being at a junction of through lines between Boston and the West, and Worcester and points in New Hampshire and northern New England. The town is chiefly noted as the largest producer of chairs in the world, although many industries of miscellaneous manufacturing character are in operation. While the largest manufacturing plants are at present operating with energy from their own power stations, the Gardner Electric Light Company serves many of the smaller and more diversified establishments, and it is probable that when the benefits of the new hydroelectric service become appreciated in the community even the larger plants will find it more economical to shut down their own installations and purchase electric energy generated at the Vernon plant of the Connecticut River Transmission Company and handled at Gardner through the substation annex of the local station, as outlined above.

Electrical supply in Gardner began in 1888, with the formation of the Gardner Electric Company. The old company had not been in existence more than a year or two before it found that it had over $70,000 invested. The price of electrical machinery was practically cut in two at this time, and this forced the company into a reorganization, since it could not carry its assets at the price originally paid for the equipment. The original plant was built with a capital of $30,000, but the demands upon the company were so great for service that $44,000 additional had to be invested, making a total investment of about $74,000. The company was reorganized under the name of the Gardner Electric Light Company and has since been successful, paying dividends varying from 8 1/3 per cent to 10 per cent.

A singular feature of the power-plant work of the company is found in the absence of any direct-connected alternating-current generating machinery in its service at any time since its establishment. The early equipment was built for 133-cycle service, and was driven by high-speed horizontal engines of the Fitchburg condensing type, belted. Later the system was changed over to 60 cycles and 2300 volts, the original apparatus having been wound for 1150 volts. Originally the generating units consisted of two 500-volt direct-current generators, one 20 kw and the other 50 kw, both driven by Buffalo and Sturtevant engines. About five years ago the first oil engine was installed. This was a triple-cylinder, 225-hp American Diesel machine. About three years ago two more 225-hp Diesel engines were installed, with shafts coupled together to form a single engine unit of 450 hp. The steam equipment was then used but little. Previous to the time when the Connecticut River Transmission Company began furnishing the electric energy, the load was handled almost entirely by these oil-engine equipments belted to alternating-current and direct-current generators.

The improvement in plant economy brought about by the introduction of the Diesel engine installation is illustrated by the cost of energy at the switchboard before and after these machines were added to the station. The following table shows the cost of energy at the station for the past five years:

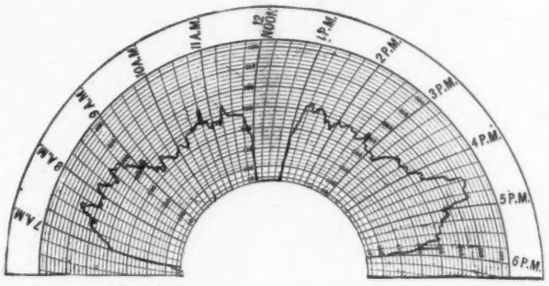
COMPARISON OF COSTS, 1905 TO 1909, WITH STEAM AND GASOLINE-ENGINE GENERATION, DURING WHICH THE COST OF COAL PER TON VARIED FROM $4.18 TO $4.61.

Year.	Kw-hours at bus.	Total cost at bus.	Cost per kw-hour at bus, cents.	Cost of oil per gal., cents.	Notes.
1905...	353,477	$13,163	3.7	..	480 hp, steam only
1906...	377,013	11,100	2.9	3.5	705 hp, 1 Diesel
1907...	447,864	12,020	2.7	3.9	705 hp, 1 Diesel
1909...	857,530	13,146	1.52	3.6	1155 hp, 3 Diesels
1908...	654,690	13,953	2.12	4.1	1155 hp, 3 Diesels

These figures show that the introduction of the oil engines resulted in noteworthy economy per unit delivered at the busbars and excluding fixed charges. On account of the company's reduction in power rates for motor load and its aggressive policy in securing new business the output at the station increased about 114 per cent in the four years ending June 30, 1909. This growth in business also contributed to the lowering of the unit cost at the station, but as the output stood practically still during the years of 1905 and 1906 the reduction in cost for this period is evidently due entirely to the substitution of oil engines for steam equipment. In the next year, 1907, the slight gain in economy of production is mainly due to the increase in output, the station equipment remaining substantially the same. In the spring of 1907 the above-mentioned reduction in rates was made, and the next year's business, as indicated by the output at the station, was almost 50 per cent more than before, giving the plant the incidental but important advantage of a better load factor. The brunt of the load in 1908 was carried by three Diesel engines which had now been installed, and in spite of a rise in the cost of fuel oil, the generating cost was still further reduced to 2.1 cents. Again, in 1909, the active commercial policy and extension of load had its natural influence upon the station cost, and with a reduction in the unit cost of oil to assist, the notable increase of output brought down the kw-hour cost to 1.52 cents; not a bad figure for a belted station of so varied an equipment and of such moderate capacity.

The present equipment of the power station, covering apparatus mainly held in reserve or operated but a short period of each day, includes the two 225-hp Diesel engines coupled as one unit and belted to a 190-kw, 500-volt Triumph direct-current generator. Also belted to these engines, but normally running light when they are in operation, is a 300-kw alternator wound for 2300 volts and available for emergency lighting service in case the supply from the hydroelectric substation should be interrupted. The first Diesel engine is held in reserve, not being connected to any equipment, but in an emergency it can be belted at once to either a 150-kw, 500-volt Stanley direct-current generator or to a 200-hp induction motor, which would then be run as a 2300-volt alternating-current generator.

Under the usual conditions of operation from the transmission company's lines this induction motor is belted to the 150-kw generator just mentioned, thus providing for the day load without the operation of the Diesel engines. Late in the afternoon of each day, however, the direct-current load tends to increase beyond the capacity of the motor-driven 150-kw machine, and under the present arrangements it is necessary to start the Diesel set to operate the 500-volt motors in the town over the peak of that service, which ordinarily lasts from 4 to 5 p. m. This motor load increases largely on account of the work of "pouring off" in certain foundry installations, which calls for extra blower capacity, and also on account of the lighting of one or two factory installations operated on the



Recording Ammeter Chart.

direct-current service. A typical daily load curve for the 500-volt service is shown in the accompanying reproduction of a recording-ammeter chart. This relatively large day load is an important factor in keeping the station conditions favorable to economical use of the hydroelectric service.

The company has begun to introduce alternating-current motors in its territory, and the heaviest work of the future in Gardner will be handled by the alternating-current lines, depending upon the attitude of the local manufacturers toward the hydroelectric power now being distributed in the community. While it is true that the operating simplicity of the system has been somewhat hampered by the growth of the 500-volt service in the town, this service has proved to be so useful in strengthening the position of the company in the industrial field and has done so much to improve the conditions of station economy that it has been well worth while. The Gardner company has appreciated the fundamental fact that revenue and a suitable profit therefrom are more desirable than the mere attainment of a high station efficiency.

The high-tension supply is taken from the lines of the Connecticut River Transmission Company at a point about 1.5 miles north of Gardner. The transmission company operates two three-phase lines between its generating station at Vernon, Vt., and the important load centers in Worcester County. At Warwick and Royalston the high-tension lines pass through switch towers which permit of sectionalizing in case of trouble. Near Fitchburg a third switch-tower installation is in service, and beyond this point the two lines are carried southward to Worcester via Clinton. The Gardner branch line is a single three-phase circuit taken off the main lines between the Royalston and Fitchburg switch towers. The Gardner line may be thrown upon either of the two through transmission circuits by suitable switch connections at the junction point.

The line is carried upon steel towers to a point just outside the Gardner substation, where taps are taken off for connection with a horn type of lighting-arrester installation, with further connection to an aluminum lightning-arrester equipment housed in a structure at the base of the last tower. Outside the substation knife selector switches are installed in the line, which is then carried into the building through concrete and asbestos windows. The substation proper is about 35 ft. long by 30 ft. wide and contains three 500-kw, water-cooled transformers, 66,000/2300 volts, with provision for 6600-volt supply. The wires are spaced on 48-in. centers inside the building, which is a brick structure. Solenoid-type high-tension oil switches are installed in the 66,000-volt line on a platform above the floor, and on the secondary side of the service a 2300-volt oil switch installation is in operation. From the transformers the low-tension line is carried to the oil switch, and thence to the busbars of the old station, knife selector switches being installed as an additional precaution just before the cable connections are made at the switchboard. City water is at present used for transformer cooling, but a 2-hp Rumsey triplex motor-driven pump is being installed for supplying cooling water from Crystal Lake. A 55-cell storage battery is installed for operating the oil switches. It is charged from the 500-volt service through a suitable resistance. Two sets of 2300-volt busbars are in service in the station, and the outgoing feeders can be operated on either set at will. The transformers and high-tension apparatus was supplied by the General Electric Company and the storage battery by the Westinghouse Company.

At the commercial office of the company a continuous exhibit of electrical appliances is offered to the public in connection with excellent accommodations for the transaction of business. The exhibit consists of the usual later types of fan motors, flatirons, percolators, radiators, ornamental shades, small motors, etc. This continuous exhibition has been going on for about two years and has been successful in arousing popular interest. The company put out 100 electric flatirons last summer, mostly on 30 days' trial, and many of these were retained in service by the consumers.

The regular lighting rates of the company are 15 cents per kw-hour, net, for residences, and from 15 cents down to 6 cents for stores, according to the consumption. Carbon lamps are renewed free upon the return of burned-out bulbs. The company charges 60 cents for renewal of a 25-watt tungsten lamp; 75 cents for a 40-watt lamp; 90 cents for a 60-watt unit, and $1.10 for the 100-watt size. Sparking batteries are charged at 50 cents each. For special electric heating service a rate of 5 cents per kw-hour is made, with a separate meter. The flatirons are on the commercial lighting mains and about 350 irons are in use. The rates for energy used in motors now vary from 5 cents per kw-hour for the 1/3-hp size of motor to 2.1 cents for a 20-hp installation.

COMPARATIVE STATEMENT OF PLANT OPERATION.

	1906.	1907.	1908.	1909.
Kw-hours generated	377,013	447,864	654,690	857,530
Kw-hours sold, total	210,503	327,380	468,593	624,269
Kw-hours sold, motor load	47,912	93,983	157,462	233,827
Kw-hours sold, other companies	.....	17,140	76,779	110,577
Kw-hours sold, commercial lighting	126,033	175,343	196,000	207,920
Kw-hours sold, street lighting	36,558	40,914	38,352	71,945
Gross earnings, dollars	23,708.54	28,445.40	34,844.68	41,727.82
Earnings from motor load	2,614.86	3,787.54	5,411.90	7,050.99
Earnings from street lighting, motor load	4,270.00	4,547.51	4,870.25	5,834.20
Earnings from commercial lighting, motor load	16,823.68	19,424.75	21,491.37	24,419.56
Earnings from other companies, motor load	.....	685.60	3,071.16	4,423.07
Average earnings per kw-hour sold, cents	11.3	8.7	8.2	6.7
Average motor load earnings per kw-hour sold, cents	5.45	4.03	3.44	3.03
Average commercial lighting earnings per kw-hour sold, cents	13.3	11.1	11	11.8
Average street lighting earnings per kw-hour sold, cents	11.7	11.1	12.7	8.15
Gross earnings per capita, dollars	1.97	2.36	2.90	3.48
Motor load earnings per capita, dollars	0.218	0.315	0.45	0.59
Total cost of physical plant, dollars	90,841.83	106,296.95	166,137.49	167,899.60
Approximate cost of plant per engine horse-power, dollars	129	151	143	148
Engine horse-power owned by company	705	705	1,155	1,125
Gross earnings per engine horse-power, dollars	33.70	40.20	30.20	37.00
*Operating expenses, dollars	18,390.94	20,751.10	25,844.55	25,901.97
Operating expenses per kw-hour sold, cents	8.7	6.3	5.5	4.15
Number motors installed	47	57	69	69
Horse-power motors installed	179	253	417	487
Average horse-power motors installed	3.8	4.4	6.05	7.1
Average yearly power income per rated horse-power, dollars	z 14.50	15	13	14.59

*Includes legal expenses, taxes, manufacturing and distribution cost.

In the accompanying table are shown the variations in revenue and operating expenses of the Gardner Company for the

past four years, with statistics of the number of motors installed, their rating and the average revenue per kw-hour sold in several classes of service. The figures show a progressive increase in the patronage of the company, although the average revenue per total kw-hour sold fell from 11.3 cents in 1906 to 6.7 cents in 1909. The gross earnings per capita, on the other hand, rose from $1.97 to $3.48, and the gross earnings from motor-load business per capita rose from 21.8 cents to 59 cents per annum. The average motor horse-power increased from 3.8 to 7.1 in the four years. A smaller decrease in the commercial lighting revenue per kw-hour sold is reflected in a correspondingly moderate increase in the total lighting business. In general, the table indicates that reductions in rates are followed by a response in the community which increases the total revenue far more than enough to offset the temporary loss through the stimulation of new and increased patronage which the lowered rates effect. In Gardner the company has supplemented its reduced charges by active commercial work, and the result of this progressive policy is clearly indicated in the earnings of the organization. With the further advantage of the entrance of low-cost hydroelectric power into its system the company stands in a position to carry still further afield the progress outlined in the above paragraphs.

The officers of the company are: President, Mr. Thatcher B. Dunn, Gardner; vice-president, Mr. Malcolm Chace, Providence, R. I., and secretary and treasurer, Mr. Frederick S. Whittemore, Gardner, who has had active management of the organization since its early days. The directors are: Messrs. Dunn, Whittemore and Chace; and William W. Brooks and Philip Young, Boston.

SOME METHODS OF IMPROVING CENTRAL-STATION ENGINE ECONOMY.

By William Westerfield.

IT often happens that on account of very simple and easily corrected errors small, and even medium-sized, power plants are operated under conditions of such wastefulness as to amaze those who understand how easily it is to correct them. Yet the conditions I am about to describe are not unusual to engineers who have had a wide experience in power-plant operation or supervision, though there may be some who having spent the most of their lives in a first-class plant where everything is done for economy and might be inclined to doubt the existence of such conditions where engineers are employed, or where men are ostensibly operating power plants for the purpose of making money.

In one plant there was a small automatic engine having cylinders 12 in. x 12 in., belt-connected to an alternating-current generator of 75 kw capacity. The engine flywheel from which the generator was belted was 60 in. in diameter and the speed of the engine was 275 r.p.m., that of the generator being 900 r.p.m. This gives an 18-in. pulley on the generator. This engine was used on the light-load period, except when motors of the induction type were to be used, and then patrons were required to call the engineer and advise him of their intention to operate the motor, when the larger engine would be started. The smaller engine would have cared for the load after the motors were started, but the starting current was so great that the engine would not handle the load at starting, which made it necessary to operate the larger engine under very wasteful conditions—that is, with about one-fifth load.

A new engineer finally was called to take charge of this plant, and the first thing he did was to determine whether the flywheel would be safe at a rotative speed of 325 r.p.m., as this was the only problem the solution of which, in his opinion, had any important bearing on the proposed change of speed. In order to make assurance doubly sure on this point, he wrote the builders of the engine asking for their advice, and was assured that while their guarantee on the engine did not contemplate this speed, they considered it perfectly safe. Then the engineer secured a 22-in. pulley for this generator and adjusted the governor of the engine for a speed of 325 revolutions, after which the small engine was capable of starting the motors, and, after starting them, carried the load with ease, the indicator showing, as in the accompanying diagram, that steam was cut off at about one-fourth stroke.

The heavier engine, which was used on the peak hours, and, as before stated, when it was desired to operate motors, was a 16-in. x 36-in. Corliss, which was belt-connected to a 100-kw alternating-current generator. The speed of the generator as rated was 720 r.p.m. and the engine was run at 110 revolutions with a maximum load of 80 kw. The engine flywheel was 14 ft. in diameter, and that of the generator pulley was 26 in.

Cards from High-Speed Engines.

With the maximum load, the engine operated with the steam valves cutting off at about one-eighth stroke. The new engineer asked for another pulley for the generator having a diameter of 20 in., which gave the engine a speed of about 85 r.p.m. when the generator speed was 720 r.p.m., as rated. The engine then operated with a cut-off at about one-fifth to one-fourth stroke.

It should be observed that in this case two opposite errors were made in operating the engines. In the case of the smaller engine the speed was too slow to enable it to handle the load it was capable of handling economically, while in the case of the larger engine the speed was too fast for economical working. The valves in the larger engine had been cut and were leaking badly, as a result, perhaps, of running the engine without oil or with insufficient quantity for good lubrication. The new engineer resurfaced the valves by draw filing and finished by grinding them on their seats with emery. As a result of these changes the fuel consumption from 6 p. m. until midnight, which, of course, included the peak hours, averaged 2100 lb. of slack coal where it had formerly required an average of 4900 lb. to do the same work.

The writer also had personal experience with another plant which furnished power and light for a city of about 8000 people. It consisted of two engines of 150 hp each, driving by belt-connection one alternator and two direct-current machines operating in series and also one 80-hp engine belted to one small alternator and two direct-current machines, also operated in series. One of the alternators was of 60 kw, one of 45 kw, and one of 15 kw capacity. The larger direct-current sets were of 45 kw each, and the small set consisted of two 15-kw Edison bipolar machines of a very early type. In this case the two larger engines were greatly overloaded, and the generator pulleys were of such diameters on one of the direct-current sets that the engine could not be run up to its proper speed; and in the case of the other, the pulleys on the generators were of such size as to make it impossible to run the driving engine fast enough on the heavy load to get the voltage up as high as was required. This made it necessary to depend entirely on one engine during the peak-load period, and this engine was, as just stated, operating under a serious disadvantage from the slow speed on account of the generator pulleys being too small.

The load on this plant had increased so that on Saturday night, or when a show happened in town, it was impossible to keep the lamps bright, especially those supplied from the direct-current circuits. A new engineer was secured for this plant when conditions had become so bad that toleration on the part of patrons of the plant seemed about at an end. When he arrived he found one generating set out of three that could be operated, and the engine driving this one operated after the fashion of a steam hammer. Everything, in ad-

dition to being run down generally, was covered in dirt. Among other up-to-date practices the assistants had been taught to take the oil can and "squirt" oil on the commutators and collector rings just as might be done on a bearing of a machine. As a result, they acted as dirt catchers. The new engineer went to work on the plant, first ordering suitable pulleys to enenable him to get the engines operating at higher speeds in order to enable them to carry the heavy loads, and while these were on the way he used the help that had formerly been engaged chiefly in holding down some greasy chairs in cleaning up the machinery and the engine and boiler-room floors.

The engines had been run without a steam separator in the steam pipes, and as the flow of steam was very rapid when the engines were overloaded, as they were during the critical hours, there was some trouble on account of water, and at all times the steam contained a great deal of moisture. This had to be knocked out through the exhaust pipe, and in this way a good deal of heat was wasted that could have been saved. The new engineer asked for a receiver or accumulator separator for each of the engines, and a steam trap through which to discharge them. These items cost about $175. About this time another plant in the same town had an engine wrecked by water in the cylinder and the repairs cost over $250. This gave the new engineer a "talking point" with the result that the separators and trap were ordered and in due time installed. Before the installation of the separators the header and steam pipes vibrated very badly, but after they were installed this vibration ceased. The vibration was caused by the surges of the steam in the pipes due to the admission and cut-off at the engine, which has the effect of causing sudden changes in the rate of flow of the steam. With a large separator a large volume of steam is stored at the engine throttle to draw on, and this does away in a great measure with the surging in the pipes, gives a more uniform rate of flow of the steam and maintains a more nearly uniform pressure of steam at the engine throttle.

In addition to the above results, the condensation and entrained water instead of being exhausted to the atmosphere, after having passed through the engine cylinder, where its effect was to wash off the oil from the wearing surfaces and interfere with proper lubrication, was discharged through the trap into an open type feed-water heater and returned to the boiler. After the new pulleys were secured and the speed of the engines increased there was no further trouble on account of dim lights; and while it may seem unreasonable, the writer can state it as a fact that the cost of fuel per output was reduced a little less than one-half.

The lesson taught by these observations is one that may be applied in many plants where the economy could be improved by making simple changes such as are here mentioned. It is safe to say that the speed should be such, where conditions permit, that the engine will operate at the greatest efficiency under the average conditions of load. Engines are usually rated by the builders for speed, and the speeds given are what is considered standard for that particular engine, but it is possible, and is often wise, to vary either one way or the other from the standard speed.

Very often after an engine has been installed to handle a certain load the engine may be able to carry the load with a cut-off of one-fifth to one-fourth, but later, on account of increase of load, the cut-off may be much later, and while the engine at first may have been very economical it may under the later conditions become very uneconomical. In such a case the solution of the problem lies in increasing the speed of the engine if it can be done safely. It is a fact that many engines are thrown out when it would have been possible to have operated them for years with economy had these simple matters been promptly taken care of. The usual rated speed for Corliss engines 16 in. x 36 in. is 90 r.p.m., but a well-designed and well-built engine of this type and size is easily capable of operating at as high as 130 r.p.m., and I know of several of them that are operating at 150 r.p.m.

Let us understand what these changes mean in the production of power. Assuming 100 lb. initial pressure at the engine piston with valves cutting off at one-fourth stroke, and the engine having a cylinder 16 in. diameter and 36 in. stroke and running 90 r.p.m. In this case the indicated horse-power will be approximately 187. If we assume the same initial pressure and point of cut-off and increase the speed of the engine to 130 r.p.m., the indicated horse-power will be approximately 272. In view of these possibilities of increased power output it would seem that when a new engine is contemplated the power-plant owner should think twice before throwing out a good engine and installing another. It is easily possible to carry this idea too far unless judgment is used. There are a number of things to be taken into consideration, such as safe flywheel speeds, etc., and these matters should have the consideration of a competent engineer and no chances taken. In any event, it might be much cheaper to purchase a new flywheel for an old engine than to buy a new engine and junk a good old engine.

The following instance shows what is possible even with some old engines. A 24-in. x 48-in. Corliss engine of Hamilton make had been in use nearly 20 years. This engine was designed to operate at a speed of 70 r.p.m. It is now, and has been for the past five years, operating at a speed of 95 and is apparently good for many more years of service.

In closing, it might be said that these observations do not apply to engines which have their speeds fixed by being direct-connected to generators. In such cases the only remedy for a case of overload is to decrease the load or install another engine and generator.

ALTERNATING-CURRENT MOTOR STARTERS.

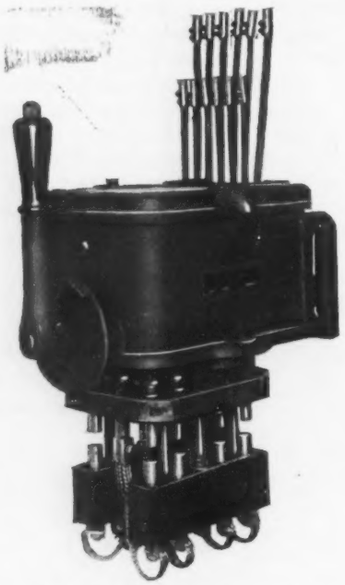
By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

By the industrial engineer and factory manager selecting the type of electric drive for the works, the apparatus offered for starting the motors is subject to more scrutiny than electrical manufacturers seem to realize. The manager's capital is his machine tools. Every moment any one of them is idle means a loss of just so much out of the gross profits of the company. It is worse than that, for the tool's work must be done by another one not so well adapted, and this in turn entails further derangements all down the line, so that the whole machinery of production is harassed by the loss of one of its cogs. Far rather a little less electric efficiency than a total loss of the services of some important tool or of even one of the minor ones. Wherefore, while simplicity and ease of upkeep of induction motors are cheerfully granted, and their adoption favorably considered, the choice of starting equipment is considered of as much importance as the choice of the motor itself.

Granted that the various makes of motors are practically equivalent in all essential details, the contract invariably goes to the maker offering the most fool-proof, durable and capable starter. By capable is meant the ability to start the load without excessive demands on the main generators; ability to return to the "off" position on failure or interruption of the circuit, and ability to break the circuit on overload. These requirements are essential to good industrial-plant service. The starter must meet satisfactorily such operating conditions as these: If a feeder switch at the power house is opened, every starter should instantly fly to the "off" position so that it will not be necessary to notify every single department having motors fed from that circuit to put the starting handles in the "off" position. Otherwise every blown feeder fuse or circuit-breaker would mean half an hour's work getting controllers ready to start again before the feeder switch can be closed. One should not be able to start the motor and go off leaving the handle in the starting position, since then it would be necessary to keep a man running around the plant continuously to see that no starters are being burned up from this cause. The fuses should blow on overload, for if the load gets so heavy that the motor is slowed down and takes nearly twice normal current, and the fuses still hold, it is evident that no protection

is afforded at all. Considerations such as these were first entirely ignored, as there were troubles enough with the drum of the starter, whose fingers were always getting burned out, even though submerged in oil.

Motors are usually started by some subforeman and rarely by the works electricians. It must be so by the nature of manufacturing processes. Such individuals have a very hazy notion of the whole subject of three-phase current, most of them laboring under the delusion that the middle leg is the neutral, and they are entirely satisfied to let well enough alone as soon as they see the motor moving. If the design of the starter is such that it can be left in the starting position, in about half an hour trouble occurs and the electrician finds the starter red hot, with its fingers burned off and its insulation melted down. The motor is also too hot to touch, and he and his whole apparatus are regarded with disfavor. The foreman usually swears he left the handle on the running position, and



Auto Transformer Motor Starter.

if the manager investigates he is at once submerged in a maze of recriminations and denials. Now the blame for all this lies directly at the door of the electrical manufacturer who places such a starter on the market. It is just as important to have a fool-proof starter as one that will get the motor going. More so, in fact, as electricity is only tolerated as a necessary evil in most large plants. In one practical starter on the market the left-on-starting-position nuisance is eliminated and the handle flies back to the "off" position if left anywhere but on "running." This is effected by a simple catch device, notch omitted at "starting," with a spring acting on the handle. To show how little factory conditions are appreciated by electric manufacturers there was a starter on the market which had no less than 27 leads coming out of it, with two satellites in the shape of cast-iron transformers with concomitant fuses, etc. When this collection was placed around a 100-hp motor one could not see the motor for the starting utensils. As if this was not enough, the only way to get at the figures of its vertical drum was by screwing down a shell a yard high. It did not seem to worry the designers any that this called for a brick sump 3 ft. deep in the floor, which sump must be drained and, therefore, impossible if the drains happen to be only 2 ft. below the floor. In another practical starter the handle not only flies back when released at any other position than running, but a gravity catch holds the switch at "off" position unless it is passed at full speed before the notch can fall. Without this it would be a rather fair device, but the experience with this trinket when put on before, out in large works, without any flyback spring, was that the men either broke the catch or the handle on about the second trial. It snapped like glass when a big, two-fisted mechanic got his hands on it. On the opposite side of the controller is a no-voltage and overload release solenoid, which solves the fuse problem.

As now installed, fuses for induction motors are of little value. The starting side is connected direct to the line above the fuse, and the running side below the fuse. One would gather from this that it would be feasible to fuse the motor just a little above normal amperage. So it would, if one would only wait till the motor reached normal speed. Experience has shown, however, that induction motors are fused for from two to three times normal current to offset the effects of too rapid manipulation of the switch. The result is that when some one abuses the motor by piling on twice the usual load the fuses offer no protection and the motor is ruined. A solenoid can be set and locked at a little above normal current and on starting if the release opens it is easy to try again. Workmen will not tamper with this device as they are afraid to touch anything that carries current. Further, if the feeder circuit-breaker opens, or a fuse blows on the main switchboard, the switch can be closed again with the assurance that the starters will all be on the "off" position.

These matters may seem trivial, and were evidently held of small importance by manufacturing companies for a while, but in the industrial field they mean either approbation or detestation of the entire electric equipment.

THE LAYING OF VITRIFIED CONDUIT.

Considerations Governing the Choice of Route, Type of Conduit and Method of Installation.

By Harry C. Spillman.

The building of the ducts for an underground conduit system involves a number of details which should be planned beforehand in order to save numerous changes and expense as the work progresses. In this way considerable less trouble is experienced in cleaning the ducts and pulling in the cables. Moreover, a conduit system well built and showing considerable foresight is a great credit to the engineer.

In planning a new conduit line, the engineer must first consider the most direct route, he must thoroughly investigate the different kinds of pavements in the streets, and the sewers should be given considerable thought. He should find out the size and depth of the sewers, how they are built and of what material and whether they are of ample size to carry away the water in times of freshets. A good sewer system paralleling a conduit line is a valuable asset, because it not only keeps the street in a good condition, but it allows each manhole to be properly drained. This is of vital importance.

The engineer in choosing a route should give preference to paved streets, because the ducts placed there are less liable to be disturbed or tampered with after their installation, while when they are installed in an unpaved street the city might decide at some future time to pave the street and change the grade, the alterations would be likely to affect the conduit line. Resident streets should be given the preference over the business streets, as along them there are fewer obstructions and less traffic. Alleys should be avoided, because in most cities the parties who own property on both sides have complete ownership of the alley; the writer has known of instances where underground passages have been built across the alley. and also when the alley has been closed up.

After the proposed route has been decided upon the engineer should ascertain from authoritative sources the exact location and depth of sewers, water and gas mains and other obstructions likely to be found in the streets. This information will enable the engineer to decide on the best location in the street for his ducts, and warn him of difficult obstructions which will have to be overcome. It is always advisable to keep away at least 2 ft. from a water or a gas main, so that future service pipes can be tapped into the mains without interfering with the conduit line. It is also advisable not to build directly over

other mains or sewers, as they might have to be disturbed at some future time to the injury of the ducts.

In drawing up the specifications, the most satisfactory method is for the engineer to obtain the necessary permits from the city to tear up the streets and all other permits to be secured by the contractor. This arrangement assures the engineer that he will not be delayed by the city after the contract has been signed and thus leaves the contractor responsible for the minor permits, such as tapping into the sewers and the like, and relieves the engineer from considerable detail work. Sometimes difficulty is experienced in obtaining permission to go under the tracks of a steam railroad, and this matter should be taken up with the railroad several weeks before attempting to cross, as such affairs have to pass through the engineering and legal departments of the railroad company before the general manager will approve of the signing of the order.

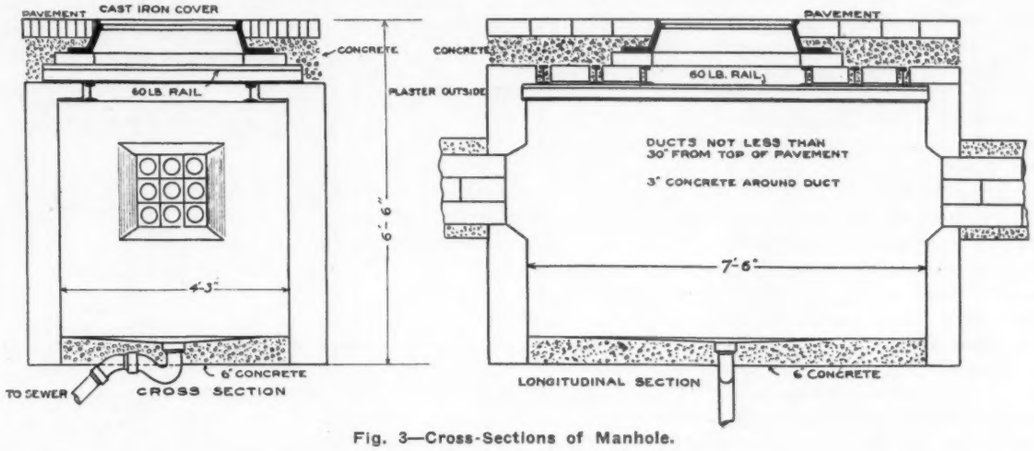
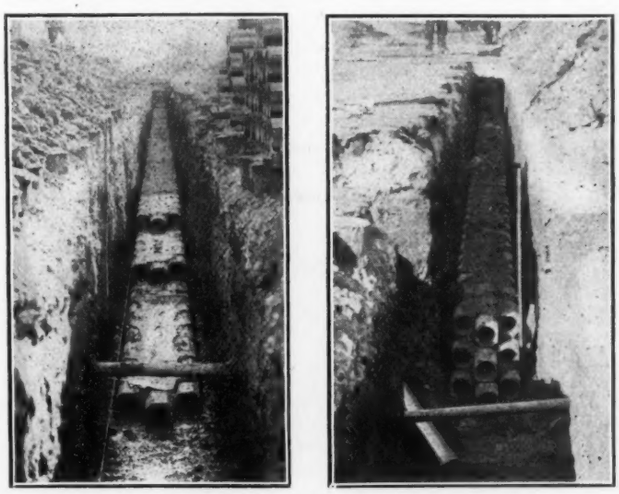


Fig. 3—Cross-Sections of Manhole.

Regarding the proper size and style of ducts it is general practice to use a multiple duct for telephone cables, while a single duct with a round bore gives the best satisfaction for energy transmission cables. The inside diameter of the duct should be at least 0.5 in. larger than the outside diameter of the cable, in order to allow for any slight kinks or bends in the cable when pulling in and to give sufficient room so that there may be no undue pulling or unnecessary abrasion of the lead sheath. The manufacturers of vitrified conduits generally make the bore of the ducts about 0.25 in. larger in diameter than the size specified, in order to allow for any slight irregularities in the ducts themselves and in installing them.



Figs. 1 and 2—Laying Vitrified Conduit.

It is a common error in building manholes to make them so small that there is not ample room in them for the men to work. A manhole should be not less than 4.5 ft. in width inside, at least 7.0 ft. long and of sufficient depth to allow a man to stand up within it with ease. The walls should have long easy curves instead of sharp corners, so that the cables can follow the walls without requiring any unusual kinks or bends; trouble, in operating, is liable to occur if the cables are given sharp bends. It is extremely important to have the manhole properly drained.

Considerable trouble is experienced in pulling in cables over 375 ft. in length, but there are instances where 400-ft. cables have been pulled in. In a well-arranged system the manholes should be spaced about 350 ft. apart, there being about three manholes for every 1000 ft. The exact location or distance between manholes can rarely be determined beforehand. It is a good policy to select the location for the manholes during actual construction; quite often during installation obstructions of such a nature are encountered that the most satisfactory way to pass them is to build a manhole at that particular place.

After all details have been arranged and the work actually started, the engineer should see that the entire trench from manhole to manhole is opened and excavated at least 4 ft. deep, so that all service pipes and other obstructions are exposed. It is always advisable to go over or under service pipes, if possible, instead of allowing the pipes to pass between two layers of ducts; in case it is necessary to resort to the latter method, there should be placed around the pipe dry sand instead of concrete, so as to allow for the contraction and expansion of the pipe without breaking or injuring the ducts. The position of water pipes can easily be changed, because they will bend to a certain extent. In case it is necessary to change the position of a small water pipe, the water can be easily frozen by packing salt and ice around the outside, and the plumber can make the necessary changes in a very few minutes. This method avoids digging to the water main to shut off the water. The position of gas pipes cannot be so easily changed, because the raising or lowering of the pipe is liable to form a pocket and cause trouble.

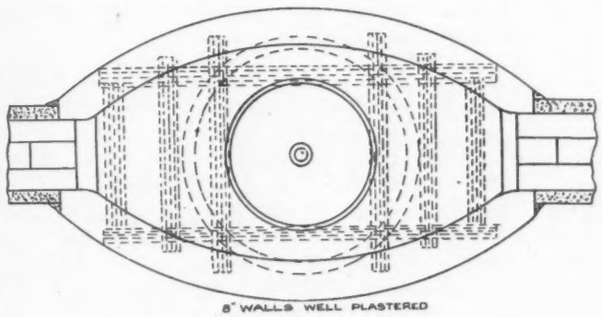


Fig. 4—Plan View of Manhole.

Grade stakes should be located by means of a level at 25-ft. intervals and a grade of not less than 4 in. to 100 ft. is cus-

tomary so that the ducts will drain satisfactorily. In grading it is not advisable to change the pitch or grade between two consecutive manholes. The contractor should excavate not less than 3 in. below the stakes, and before placing concrete in the trench additional stakes should be added 3 ft. apart. These stakes can easily be driven to the exact height by stretching a line over the top of two grade stakes, set by the instrument, the additional stakes being located by this line.

In placing concrete, a strong mixture of about "one, two and four" should be used. The top of the stakes should be left exposed; if the stakes are entirely covered there will be high and low spots in the bed of concrete which will form pockets where water can settle in the ducts and they will not be properly drained.

The concrete should "set" sufficiently to support a man before any attempt is made to lay the duct, and use should be made of a small bed of mortar of sufficient height to cover the top of the stakes, so as to form a smooth even surface for the ducts. The ducts should be laid carefully, and if care is taken in laying the single ducts, it will not be necessary to wrap the joints. Around the joints and between the tile use should be made of natural cement mortar, because Portland cement mortar has a tendency to creep into the ducts at the joints. One of the great sources of trouble is the plugging of ducts, caused by the men walking on top of the conduit and working cement through the joints before the mortar is set. After the ducts are layed, 3 in. of Portland cement concrete should be added around all the sides and top, as a protection against injury. Care must be taken in doing this so that the ducts will be completely covered, and the concrete must be mixed rather dry, as thin concrete will work into the joints and cause trouble.

In laying the ducts a 4-ft. mandrel, having a rubber washer at the end about 0.25 in. less in diameter than the bore of the duct, should be pulled through by the tile layers. A double mandrel—that is, two mandrels attached to each other by about 8 ft. of wire—proves more satisfactory than a single one in keeping the ducts clean.

After the ducts are installed a gang for cleaning out the conduits should follow up the work. An effective method is for the men to pull through the ducts a criss-cross flue cleaner having a diameter about 0.5 in. less than that of the ducts. A rope is attached to each end of this cleaner, and in case any obstruction is encountered it can be worked back and forth until the passage is cleared. This cleaner should be followed up with a chain, made into a bundle about 12 in. long and of nearly the same diameter as the ducts. This can easily be made by threading the chain through two rings made of messenger cable. In case this chain should meet any obstructions, it should be worked loose, by passing the bundle of chain over it several times. After all obstructions are loose a cotton-rope mop should be pulled through the ducts to remove any dirt or pieces of cement which may have broken off. This method of cleaning the ducts and preparing them for the cable is very effective.

COST OF LAYING VITRIFIED CONDUIT PER LINEAL FOOT.

No. of conduits.	Brick, granite, stone (grouted).	Asphalt tarred brick.	Cedar (on concrete).	Cedar or cobble (on sand).	In grass plat.	Dirt.
1	$1.15	$1.10	$1.00	$.70	$.60	$.50
2	1.25	1.20	1.10	.80	.70	.60
3	1.35	1.30	1.20	.90	.80	.70
4	1.45	1.40	1.30	1.00	.90	.80
5	1.55	1.50	1.40	1.10	1.00	.90
6	1.65	1.60	1.50	1.20	1.10	1.00
7	1.75	1.70	1.60	1.30	1.20	1.10
8	1.85	1.80	1.70	1.40	1.30	1.20
9	1.95	1.90	1.80	1.50	1.40	1.30
10	2.05	2.00	1.90	1.60	1.50	1.40
11	2.15	2.10	2.00	1.70	1.60	1.50
12	2.25	2.20	2.10	1.80	1.70	1.60
13	2.35	2.30	2.20	1.90	1.80	1.70
14	2.45	2.40	2.30	2.00	1.90	1.80
15	2.55	2.50	2.40	2.10	2.00	1.90
16	2.65	2.60	2.50	2.20	2.10	2.00
17	2.75	2.70	2.60	2.30	2.20	2.10
18	2.85	2.80	2.70	2.40	2.30	2.20
19	2.95	2.90	2.80	2.50	2.40	2.30
20	3.05	3.00	2.90	2.60	2.50	2.40
21	3.15	3.10	3.00	2.70	2.60	2.50
22	3.25	3.20	3.10	2.80	2.70	2.60
23	3.35	3.30	3.20	2.90	2.80	2.70
24	3.45	3.40	3.30	3.00	2.90	2.80

Direct sewer connections $0.50 per lineal foot. Indirect sewer connections laid in bottom of conduit trench one foot below finished bottom of duct, $0.20 per foot. Manholes, 7.5 x 4.5 x 6.5 ft. deep, $60 complete.

In the accompanying table is shown the cost of laying vitrified conduit. The cost includes the taking up of pavements and excavating of sufficient depth and width to receive the number of ducts to be laid. Allowing 3 in. of concrete in the bottom and the same on both sides and the top of the conduit. The remainder of the trench is filled with earth, properly tamped and pavement relaid subject to the approval of the city. The prices include the furnishing of all material:

DETAILS RELATING TO THE MANUFACTURE OF METALLIC FILAMENT LAMPS.

In a paper read by Mr. James Findlay, managing director of the Rugby Lamp Company, before the Birmingham (England) and District Electric Club on Feb. 12, much information was given concerning the manufacture of metallic-filament lamps.

MANUFACTURE OF THE FILAMENT.

The metal tungsten occurs in wolfram or tungstate of iron, and in scheelite and calcium tungstate. The native calcium tungstate is digested in hydrochloric acid, and the soluble calcium salt is washed out with water. The resulting tungstic acid may be dissolved in ammonia evaporated to dryness and heated in contact with air. Tungstic oxide is thus obtained. With this yellow powder the work of making the filament for incandescent lamps begins. A common method is to take tungstic oxide, mix it to a stiff paste with glucose or starch or other material to bind the powder together. The paste is put into a mold, in the bottom of which is a diamond die, and pressure is brought to bear on the paste to extrude it through the die. Difficulty is encountered in the first place in getting the tungstic oxide powder into a fine enough state of subdivision. When it is remembered that the aperture of the die is sometimes less than two thousandths of an inch in diameter, it will be readily understood that the powder must be very fine, indeed, before it can be made into a paste which will pass through. It is a comparatively easy matter to mix this powder into a paste, but the paste must be wet enough to pass through the die, and yet dry enough to hang together in thread form after it has passed through. The usual practice is to catch the thread on cardboard or similar material as it comes from the die. The board is passed back and forth beneath the die so as to spread out the thread in long hair-pin form. The filaments or threads are then dried in a gas oven, after which they are placed in boats and put into a furnace tube through which hydrogen gas is allowed to flow. Sometimes the air is exhausted from this tube by means of a vacuum pump before the hydrogen is introduced, but the hydrogen is generally left to displace the air. A considerable heat must be maintained in this furnace for several hours, the result of which is partially to reduce the tungstic oxide to tungsten. The next step completes this reduction.

The filaments are supported under a bell jar which is evacuated—hydrogen gas is admitted and the electric current passed through the filament. A current equal to four or five times that which the filament will take when made into a lamp is passed through the filament, the strength of the current varying with the pressure of the gas under the bell jar. The effect of this strong current is to burn off any remaining portion of the binding material, to complete the reduction of the oxide, and to sinter or melt the particles of metallic tungsten closely and solidly together. In order to give the filament a symmetrical shape, it is customary to hang a small weight on it during this sintering process. The weight pulls the filament straight and makes the bend small, so that the filaments may be placed close together. Care must be observed to have a weight which, while heavy enough to give the desired shape to the filament, is not too heavy. The weight must also be of a material that will withstand the very high temperature of incandescent tungsten, otherwise the weight will be welded

to the filament. This filament is now ready to be attached to the leading-in wires. Owing to tungsten being very soft while incandescent, it is necessary to support the filament at both ends, and to provide such means of support that when the filament becomes soft and extends one limb will not come into contact with another limb. This and the low resistance of tungsten renders necessary a much more expensive internal construction for the lamp than is necessary for carbon filaments.

MOUNTING THE FILAMENT IN THE BULB.

The various steps in the manufacture of the filament support are as follows: The leading-in wires consist of a piece of copper wire to which is welded a very short piece of platinum, which again is welded to about ½ in. of nickel wire. The purpose of the short piece of platinum wire is, of course, to prevent any air leaking along the wires and so impairing the vacuum. Many substitutes for platinum in this connection have been suggested, and while some of the proposed substitutes equal platinum in having practically the same coefficient of expansion, as glass, none of them is quite equal to platinum in freedom from oxidization in the flame used to melt the glass around the wires. A piece of glass tube is rotated in a gas flame, a carbon pencil is inserted in the end which the flame has softened, and by a slight movement the end is flanged out. The flanged glass tube and the leading-in wires now go to a machine where they are sealed together.

This machine has four heads, which rotate around a common center so arranged that each head comes in succession opposite the operator who puts the glass tube and wires in place, then into a preliminary fire to heat up the glass, then into a final fire, where the glass is melted, and while in this condition the operator, by means of a foot pedal, pinches the molten glass around the wires. Another movement of the machine brings the part into a postition where it may cool down before it comes again in front of the operator, who removes it and puts in position the new parts of another. The central glass rod is placed in position. The enlargement in which the wires are embedded is made by rotating the rod in a pointed flame, at the same time gently pushing the ends together. After the wires are inserted the filaments are secured in place. In a carbon-filament lamp the carbon is attached to the leading-in wires by a little carbon cement. This method, however, will not answer for a tungsten filament. Carbon is a very bad thing to have inside a tungsten lamp. The ideal way is to have an all-metal connection. This is very neatly effected as follows: A paste of nickel oxide is used to hold the filaments to the wires. The mount is pushed up into a bottle through which a stream of hydrogen gas is made to flow. The leading-in wires of the mount are connected to one pole, and a platinum point, which is inserted through the side of the bottle, is connected to the other pole.

Current is supplied through a small step-up transformer, so that when the push button is touched a high-tension arc is made between the point at which the filament is pasted and the platinum point. The heat of this arc and the hydrogen reduce the nickel oxide to metal, which forms a small globule around the filament, thereby securely welding it to the leading-in wire. The mount is turned around, bringing each joint in front of the platinum point, so that the joints—sometimes over 20 in one lamp—are all made in a few seconds. The mount is now ready to be sealed into a bulb, but some preliminary work must first be done on the bulb. As received from the glass house the bulb, of course, has no tip and it has a long neck. The first operation on the bulb—after washing it—is to make a small hole in the center. This is done by playing a very pointed flame against the center of the bulb, at the same time bringing air pressure to bear inside the bulb, so that when the flame has sufficiently softened the glass the air pressure blows it out into a hole.

A short tube is now sealed on over the hole. This tube is afterward used to connect the lamp to the exhaust pump. The bulb is now held upright in the center of a ring of pointed gas flames, arranged so that the flames play on the neck at the point at which it is wished to cut it off. The bulb is slowly rotated so that the neck may be equally melted all around. As the flames soften the glass the neck is pulled down by its own weight, so that in a few seconds it drops off and the thin glass closes over the opening. Air pressure is at once introduced into the bulb, and the thin glass bursts outward. The bulb and mount are sealed together on a machine which has a spindle to carry the mount and frames to support the bulb.

The mount is first put in position and then the bulb is placed over it, great care being necessary to avoid breaking the very fragile filaments. The mount spindle and bulb frame rotate together as one piece, and the machine consists of four arms with a mount spindle and bulb frame on each arm. This arrangement allows the operator to place the mount and bulb in position, rotate the machine, and thus bring the lamp parts into the fire, at the same time bringing another arm with its mount spindle and bulb frame in front of the operator. When the parts of another lamp have been placed in position the machine is given another quarter revolution, and the original mount and bulb are now brought into a hotter fire, where the sealing of the two together is completed. When the lamp is removed from this machine it is placed in an annealer to prevent it cooling too rapidly, and so obviate as far as possible the danger of cracking. The lamp is now ready to be exhausted.

EXHAUSTING THE BULB.

Different methods are followed in exhausting metal-filament lamps from carbon lamps.

A pump which is coming into very general use for this work is the Gaede rotary mercury pump, although some manufacturers prefer to use the old-style Sprengel mercury pump. The rough-and-ready means of connecting the lamp to the pump by means of a rubber joint, which is found satisfactory for carbon lamps, will not answer for tungsten lamps. The only entirely satisfactory method is to seal the lamps to the pump by means of the torch. Six lamps are generally put on a pump at one time. The lamps are so arranged that in addition to being connected to electric supply they can be enclosed in a heater and brought up to a good heat while they are being pumped. Very few manufacturers use any chemical to assist the exhaustion of tungsten lamps in the way that red phosphorus is used in carbon lamps. The lamps must, therefore, be left much longer on the pump, and for this reason they are not connected up singly, but in batches of six or more.

A tungsten lamp requires a much more careful exhaustion than a carbon lamp, and it is necessary to use a gage of some sort to indicate when the vacuum is good enough to permit the lamps to be lit up. For this purpose some manufacturers use a spark gage. As the exhaustion proceeds the discharge is first ribbon-like and then spreads into a luminous glow. The glow then disappears and the glass fluoresces, the discharge finally refusing to pass. As the degree of vacuum indicated by these changes varies with the size and condition of the spark coil used, some manufacturers prefer to depend entirely on a McLeod gage. In this gage the highly rarefied gas in a bulb which has been connected to the lamps and pump is compressed by allowing mercury to flow in, the compressed gas or air being collected into a carefully calibrated tube over the bulb. The total capacity of this tube and bulb are known, and the pressure in the bulb before the mercury was admitted is calculated. It is good practice to have a vacuum of about 0.0006 mm of mercury before lighting up the lamps. The lamps are on the pumps from 40 to 50 minutes, and a vacuum equal to about 0.0002 mm of mercury should be obtained before sealing the lamps off. The test by a spark coil used for carbon lamps is of doubtful value. Tungsten lamps may not show the slightest glow on the coil, and yet not have a good enough vacuum.

TESTING AND RATING.

All lamps are tested on the photometer for candle-power, and most of them are also observed for current consumption. The photometer most used in factory work is the common Bunsen grease-spot. A working standard is set up at one end of the photometer. This should be an incandescent electric lamp operating at a specific consumption which will match in color

with the lamps which are to be tested on this photometer in largest quantity. The reference standard is placed in position at the other end of the photometer bar, and is carefully brought up to the voltage necessary to give its rated candle-power. The resistance in series with the working standard is varied until the working standard and the reference standard give a balance on the photometer head, which is placed exactly midway between the two lamps. The reference standard is now withdrawn and a lamp to be tested is put in its place. This reference standard is used several times each day to keep the working standard true.

Lamps are tested either at candle-power for voltage or at voltage for candle-power. In the first case—for voltage—the spot box is fastened in place for the candle-power desired, and the voltage over the test lamp is varied until balance is obtained. In the other case—for candle-power—the voltmeter needle is held steady at the voltage desired, and the spot box is moved back and forth until balance is obtained. The photometer is furnished with a scale based on the law of inverse squares, which shows the candle-power of the lamp under test for different points on the photometer bar.

It is impossible to supply tungsten lamps which will all at their marked voltage give exactly their rated candle-power, but it is well known that tungsten lamps do not change so much in candle-power, etc., with change of voltage as do carbon-filament lamps, but these figures show that even here the change is considerable.

TABLE I.—TUNGSTEN LAMPS.—25 CP, 220 VOLTS, 35 WATTS.

Volts.	Candle-power.	Watts.	Watts per candle-power.	Life (hours).
240	34	40	1.18	500
235	31¼	38¾	1.22	700
230	29½	37½	1.27	900
225	27¼	36¼	1.33	1000
220	25	35	1.40	1000
215	32¾	33½	1.47	....
210	21	32¼	1.54	....
205	19	31	1.63	....
200	17½	30	1.72	....

Of course, much longer experience has been had with the carbon lamps than with the tungsten lamps, so that while one can say with tolerable certainty how a batch of carbon lamps will average in performance under different circumstances, he cannot be so precise in his statements regarding tungsten lamps.

Calculations of the cost of operating high-priced, high-efficiency tungsten lamps and low-priced, low-efficiency carbon lamps show that while it certainly pays to use tungsten lamps where the energy has to be paid for at ordinary lighting rates, it is not clear than any advantage is to be gained by using tungsten lamps where energy is cheap—at any rate, not where high-voltage lamps have to be used. On high-voltage direct-current circuits where transformers cannot be used to get lower voltage, lamps are sometimes used in series to get smaller and cheaper units. This may often be done successfully, but it generally, sooner or later, leads to trouble. Very few people realize how carefully lamps must be matched for current consumption before they will give satisfactory service in series.

NEW TREATMENT OF FEED-WATER.

As readers well know, in the treatment of water for boiler feed purposes, a number of reagents can be employed to effect the precipitation of the scale-forming constituents. Prominent among these are lime, soda ash, caustic soda, barium hydrate, barium chloride, tri-sodium phosphate, petroleum, tannate of soda and tannin extract. The reactions taking place are chemical in their nature so that there is nothing mysterious in the work. A correspondent in *Engineering*, of London, calls attention to a water softener which calls for some credulity. The apparatus, however, appears to have no power of softening water, but merely prevents some of the worst results that usually follow the use of hard waters in steam boilers, namely, the formation of hard scale on the tubes and plates.

The apparatus referred to consists merely of a piece of thin sheet aluminum, which is bent into a series of deep corrugations, usually about 1/5 in. wide, the corresponding depth being about 1 in. These dimensions, however, vary according to the amount of water to be treated and its degree of hardness. This corrugated strip, about 5 in. wide and some 3 ft. or 4 ft. long, is fixed in an almost vertical position (actually about 86 deg. from the horizontal), and the water to be treated is fed to it from a kind of hopper at the top, through a number of small tubes, each of which leads into one of the corrugations of the apparatus. The amount of water flowing down the corrugations is just sufficient partially to fill them, but not to overflow their tops. From the bottom of the apparatus the water falls into a storage tank, and this is all the treatment that the hard water is said to receive.

Now one would naturally expect that such a piece of apparatus, put to such a purpose, would prove futile in attaining any useful end. Yet, according to our contemporary, the evidence that comes from numerous sources, and from men whose word is beyond doubt, proves clearly that something has happened to the water during its passage down the aluminum corrugations, and the change brought about enables it to be used in steam boilers without danger of hard scale being deposited on the plates and tubes. Careful inquiries into the matter, and visits to works where the apparatus is installed, brought out the fact that water which before being passed over the "Luminator" (as the appliance is called) gave great trouble by the hard, flinty scale it deposited, has, since the application of the apparatus, ceased to give any trouble, all the precipitates from the water forming only soft mud, which can be easily brushed away.

More than this, also, the treated water is said, after being in use for some time, to bring off old hard scale. In one railway establishment the apparatus had been in use for about six months, and was then treating nearly 1000 gal. of water per hour, the water being used in both locomotive and stationary boilers. This water has a hardness of from 20 grains to 30 grains per gallon, and had given much trouble before the apparatus was installed, owing to a very hard deposit of flinty scale, which required chipping off at frequent intervals. Now, this trouble seems to have disappeared, all precipitates being easily washed or swept out.

The question will be asked, "What happens to the water during its passage over the aluminum corrugations?" To this there seems to be at present no satisfactory answer. That the change in the nature of the water is not chemical is clear, because analysis of the water before and after treatment shows that there is no difference in the chemical constitution, and, so far as the proportion of soap-destroying constituents are concerned, the water is practically unchanged. One theory brought forward is that the ultraviolet rays of light are responsible for the results noticed; but it seems that, in certain places where this apparatus is working satisfactorily, these rays are few in number, which fact is, of course, somewhat against this theory.

It is stated, however, by the manufacturing establishment introducing the apparatus that where water is passing over the "Luminator" continually day and night, without any break, it is necessary to give the apparatus 12 hours' continuous rest during daylight every seventh day. If this be a fact, it looks as though light had something to do with the action of the apparatus. In confirmation of this, experiments seem to show that in the treated water calcium sulphate precipitates as a finely divided amorphous powder, and that magnesium sulphate is completely ionized, the magnesium being precipitated as a fine powder. Moreover, any nitrate or nitrite in the water is also ionized, the nitric or nitrous ion disappearing, possibly in the steam, the sodium with which it was originally associated being left in the water in solution, to be found when blown out associated with the sulphuric ion originally associated with the magnesium. This last fact seems to corroborate the claim that the process also prevents corrosion. The uncertainty as to the cause of the action of the apparatus is, of course, unsatisfactory, but no doubt some acceptable explanation will in time be forth coming. The matter is said to be undergoing investigation at the present time at the Imperial Torpedo Works, Friedrichsorb, Kiel.

LETTERS ON PRACTICAL SUBJECTS

PILOT LAMPS AS A MEANS OF REDUCING METER BILLS.

Consumers have a right to complain about high meter bills, and these complaints should be met with courtesy from the central station manager. To send a meter tester to the complainant and inform him that his meter is correct does not always give satisfaction, especially when the consumer has figured his consumption by keeping account of the number of lamps and hours of burning. To satisfy such a complainant is not an easy task. In one case which came to the writer's notice a careful examination was first made of the installation. Everything seemed to be all right, and apparently all illumination was done as economical as possible, most all living rooms being equipped with high efficiency lamps. But the waste took place in the cellar, which was a dark one and had two furnaces, over each of which glowed a 16-cp lamp, which the furnace man left burning. The consumer was notified and the furnace attendant was informed to turn off the electricity thereafter. This had only a temporary effect; he soon forgot quite frequently about the lamps. The carelessness on his part might have been due to the fact that the lamps over the furnaces were on each end of the cellar, and he had to walk quite a few steps in darkness before he reached the head of the cellar stairs, where the switch was installed, and thence entered into daylight or else the illuminated kitchen. It was quite natural to forget about the gloomy cellar as a person going from a lighted room into a dark one will always reach for the electric button first, but in going the reverse way there is a tendency to the contrary. The writer then advised the installation of a 2-cp pilot lamp outside the cellar door, which was lighted whenever the cellar lamps were burning and was also in plain sight of the others in the household. The next meter bill showed quite a difference in favor of the consumer, and at least one more customer was satisfied. In the writer's opinion, contractors in wiring new installations should induce the customer, whenever possible, to install such pilot lamps on all circuits which can be easily forgotten, such as those in cellars, store rooms, closets, ice boxes, etc.

Lenox, Mass. J. Franz.

AN ODD ACCIDENT TO A DAM AND SOME QUEER REPAIRS.

A certain Indiana power house contains generators driven by turbines, water being taken from a canal and the discharge from the wheels passing to the river at a lower level. For a considerable distance the canal passes inland across a bend in the river. A manufacturing concern, tempted by the very convenient locality, erected a mill at some distance from the river, and built a tail-race several hundred feet long right down the bed of the canal. This tail-race was, in fact, a decked flume with external instead of the usual internal pressure. At the lower end of the canal a massive concrete dam held the water back from the river and the tail-race passed through the lower portion of the dam just below low-water mark. For several years everything went well, the concrete dam being put in during that time, replacing the original wooden structure, which had grown weak under the strain and leaked badly. Thus, the original wooden tail-race was built into the new concrete dam. But, one day there was a great commotion below the dam, and volumes of water poured out of the tail-race and the level in the canal could not be maintained. Word went out that the new concrete dam had been undermined and was going out. The water was promptly shut out of the canal and an investigation started to determine the cause of the trouble. A coffer dam was built across a part of the canal and the water which leaked through the head-gates was turned to one side and permitted to pass to the river through an adjacent mill-race. After the water had been pumped out of the lower end of the canal, nothing could be seen but a small mud-hole, but when the top of the tail-race had been cut away, the cause of the break was plainly visible. The heavy planking had been forced upward and torn to pieces by the force of the water, In fact, the floor of the tail-race looked as if a dynamite bomb had been exploded underneath it; the heavy planking was torn and shattered in every imaginable shape, the bolts twisted like strings and the timbers broken and splintered. It was found that the best way out of the trouble was to pull out all the lower end of the tail-race and put in reinforced concrete in place of the wooden walls and roof which still remained sound. The walls were built of 2-in. by 12-in. plank, laid flat, one upon another, and spiked well to each other. Steel bars 1 in. square were placed about 24 in. apart in the bottom and in the walls of the new tail-race, which were made 30 in. thick in addition to the reinforcement. Of the concrete work, nothing need be said here, except that a mixer, motor-driven, was placed on the right-hand bank of the canal, and concrete, as fast as mixed, was slid down a wooden trough and right into the forms with no handling whatever. A couple of mistakes were made, however, during the building of the coffer dam which it will pay all power users to understand and to avoid. Cement sacks, filled with earth, were used as a foundation for the coffer dam, and the first mistake made was in filling these bags too full. The sacks stood out fat and round and the crevices between them were large enough for cats to run through. When the sacks were laid together in the water, it was found very hard to fill the interstices between them. Whenever sacks of earth are to be used to form the beginning of a coffer dam, they should be only partly filled. Then they will pack so closely together that there is scarcely any leakage of water between them, even before any earth is backed up against them. It requires a few more sacks, but the time spent in making the coffer dam tight is reduced more than three-fold by using partly filled sacks instead of very full ones. Another mistake, which did not affect the dam in any particular, but increased the time spent in building the coffer dam, was beginning the coffer dam from both sides of the stream, instead of building right through from one bank to the other. The bags were deposited in the water and the men kept working toward the center, with the result that before this point was reached there was so swift a current that the bags of earth were carried down stream. In commencing a work of this kind, the bags should all be deposited in the stream from one side. Then the current will not be so swift as to dislodge the bags of earth, for the stream will have become shallower and there cannot be such a swift and deep current at the opposite shore. The placing of sacks in shallow water is also easier. After the bottom of the tail-race had been covered with concrete and bar iron to the depth of nearly 15 in., forms were placed for the side walls which were built up about 6 ft., or to the height of the tail-race. Some 12-in. concrete piers were built in a row along the center of the tail-race and a 12-in. I-beam was placed on top of the piers to form a center bearing for the roof of the tail-race. It is perhaps needless to state that a tight floor was built underneath the concrete space and that material was then put in place and reinforced with steel enough to carry the load of water which must come on top of the concrete. It is safe to predict that the water will never break through into this tail-race again, for it is so designed and constructed that even should the water make a breach entirely through under the construction, the concrete would stay there intact, as it is supported "neck and heels," so to speak, from either end.

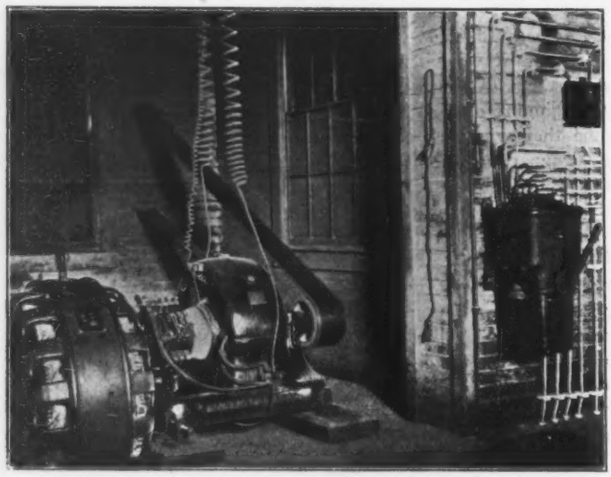
Terre Haute, Ind. James Wilson.

INTERESTING SUBSTITUTION OF MOTORS FOR ENGINES IN A FLOUR MILL.

Two motors, busily working beside two motionless and dust-covered reciprocating engines, represent another salient victory for electric motor drive, this time in a flour mill. The mill is general in nature, grinding flour, and feed, and crushing shells and rock for the manufacture of chicken feed. It is part of a two-story, main brick building, with a warehouse

leading back out on the wharf. The engines, boilers and motors are all on the first or ground floor, while the mill and grinders are all on the second floor.

Power was originally supplied by two 75-hp fire-tube boilers supplying steam to a 50-hp automatic high-speed engine and a 125-hp, non-condensing Corliss engine. The exhaust steam of both engines was used for heating the buildings and warehouses. The high-speed unit operated the barley mill, the dusters, the elevator and a 25-kw, 110-volt, direct-current generator that supplies light for the buildings and energy for the elevator motor, about 21 kw being the average load. The 125-hp Corliss operated the main part of the mill, consisting of nine vertical flour grinders, capacity 400 barrels a day; two grain dusters, one fanning mill and the necessary conveyors and elevators, by a four-strand, continuous American style rope drive. Sheaves were arranged to reduce the speed of the Corliss in the ratio of 6 to 4 with the smaller sheave on a 50-ft. shaft hung just below the second floor and carrying all the pulleys and belts for driving the machinery in the mill directly above. In the new installation none of the shafting was changed. A 50-hp, two-phase, 220-volt induction motor, running at 850 r.p.m., took the place of the high-speed engine, being arranged so that in case the electric supply should be cut



Motor and Generator in Flour Mill.

off for some reason, the high-speed unit can be used to drive the lighting generator with the same belt now used on the motor. The Corliss engine has been replaced by a 150-hp, two-phase, 2000-volt induction motor belted to the main shaft by a short 20-in. leather belt in place of the long rope drive and sheaves. No shafting has been changed and a 25-kw, 110-volt generator is arranged as an auxiliary should the other generator be disconnected for repairs. Energy is supplied to the mill at 2000 volts and at 220 volts, alternating current. Three motors, the 220-volt, 50-hp, just installed, and a 50 hp and 25 hp in use out on the docks for some time past, are supplied by the electric light company's transformers placed on poles just outside the building. The 150-hp, 2000-volt motor is connected directly on the 2000-volt mains. The auto-starter and high-tension oil switch is protected from dust and injury by a wooden box enclosure located under the stairway leading to the second floor. In this plant the exhaust steam of the engines was used to heat the buildings because the heating tunnel from them could be made straight and short, without turns or elbows. One boiler is retained to supply the heating system at about 40 lb. steam pressure. Steam is still used for heating and for cleaning musty grain. The steam engines were giving good results and coal was reasonably cheap. The system was self-contained and not liable to shutdowns due to accidents from outside sources, and the plant represented a lesser investment and gave good operating satisfaction. The reasons presented to the owner's mind in making the change were economy of operation, flexibility of the plant and decreased fire risk. This turned the day for electric drive and brought the steam plant into the market for sale. Alternating current for motors is cheap in Seattle, being sold to commercial users at about 1 cent a kw-hour, and at 4 cents for lighting. On this basis it was found profitable to install an alternating-current motor and keep the 110-volt generator to supply the lamps and elevator motor in preference to buying energy for light directly. About 19 kw is the average lighting load in the buildings, which gives a saving of 57 cents an hour to be balanced against the interest on investment in the generator and the loss of efficiency therein. With the steam plant about $1,060 a month was paid to supply the necessary light, heat and power, and a fireman was needed to fire the boilers. With the motors operating the mill and one boiler used for heating, the engineer does the firing and the induction motors need little attention beyond oiling. The motor drive has been installed only a short while, but the monthly bill for energy shows a very appreciable decrease. The motors, meters and wiring were installed for $4,000. The old Corliss engine, sheaves and rope drive are worth about $1,600, leaving a total new investment of $2,400. Induction was the only kind of motor considered in this installation, as the flour dust sifts in through nearly any protection and makes commutator sparking almost unavoidable in direct-current machines. Flexibility probably accounts for a part of the reduced operating cost, as the rock and shell crushers, the barley mill, hay bailer and flour mill are now independent of each other. Each part of the mill is in operation some part of nearly every day, but only the lighting plant every day. Probably the peculiar advantage of the electric drive in this case is the elimination of the rope drive and the utilization of part of the space formerly occupied by it and the engines. The Corliss had a floor space of 200 sq. ft. and the rope drive was 40 ft. long. The motors now occupy about 100 sq. ft., leaving the remainder for use in the mill. In a flour mill, fire and fire insurance are carefully considered. The fire insurance rate on this mill has been reduced because the plant now has merely a low-pressure heating system in operation. Although the total cost is greater and the fixed charge for interest greater, the total operating expense, including fuel and maintenance and depreciation, is less, representing a considerable saving in dollars and cents.

Seattle, Wash. Louis P. Zimmerman.

Novel Method of Foundation Construction.

It is seldom indeed, now-a-days, that engine or generator foundations are constructed of stone or brick. Concrete has the preference, and monolithic concrete, poured right on the spot, forms the substance of nine-tenths of all the foundations constructed. No better foundation was ever constructed than one made of concrete, but the cost of the forms in which to pour or rather to ram concrete is great, especially with large, high foundations and those of elaborate or intricate design.

To construct a foundation which possessed all the advantages of monolithic work, and one which avoided the entire cost of forms, was the problem which confronted the writer and which was solved as hereinafter described. The material at hand was good gravel, ranging from 2 in. down to fine sand. As no attention was to be given to the smoothness of the foundation which was largely below the surface of the ground, a larger size of gravel could be used than would be convenient were the foundation visible, hence it was decided to use material up to 1 in. in diameter, and everything above that size was screened out of the gravel. It was not thrown away by any means, but every large pebble was saved and used as will be described later. The foundation was built of 8-in. hollow blocks, laid in grout, and the hollow spaces filled with grout and the large pebbles screened from the gravel used in the blocks. In this way, great solidity of construction was secured. The matter of inserting the necessary anchor bolts became very easy, for the blocks were so arranged that the bolts passed through the hollow spaces or cores, and after the foundation was fully erected and the bolts were exactly in place, thin grout was poured around the anchor bolts and the whole foundation was firmly tied

together. Granted that the labor of making the concrete into blocks was greater than the cost of labor for building the forms, it was not much more, and the cost of the material for forms was entirely eliminated. With two block machines purchased for the purpose, the blocks were all made up by two men at over 200 blocks per day, and at that rate the necessary number

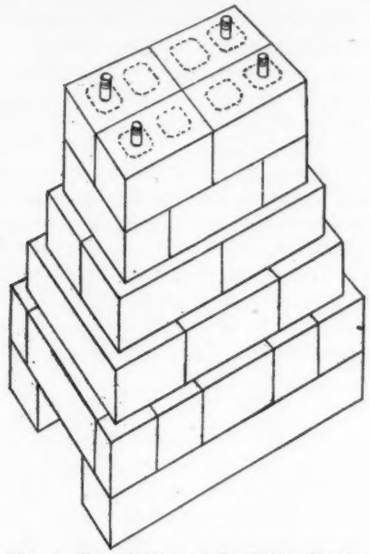
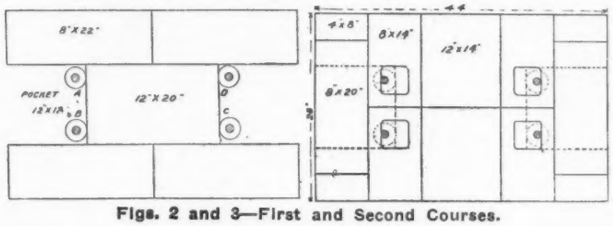


Fig. 1—Foundation of Concrete Blocks.

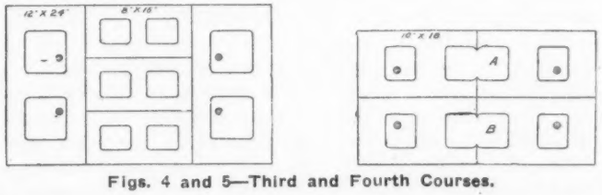
of blocks for even a large foundation could be quickly made. By this method it it possible to have the blocks made up at odd times, and any number from a single block to a full day's work can be made without the least waste of material.

For the purpose of illustrating this method of foundation construction, the design made for an out-board pillow-block foundation for an engine is reproduced herewith, together with



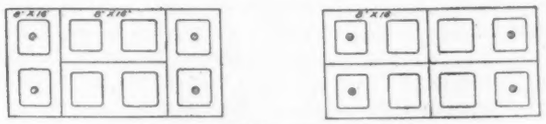
Figs. 2 and 3—First and Second Courses.

the detail drawings of each of the six courses of blocks. Each block being made 8 in. high, or thick, the foundation will therefore be 48 in. high and 16 in. x 32 in. on top, corbled out 6 in. on a side in three 2-in. steps, thus making the footing 28 in. x 44 in. Four 1¼-in. anchor bolts were placed in this foundation, and they are shown in Fig. 1, projecting above the foundation from four of the cores which were originally formed



Figs. 4 and 5—Third and Fourth Courses.

in the blocks. These cores were afterwards filled with large gravel and thin cement grout and their location is indicated by the dotted lines on the top of the foundation. Fig. 2 shows the first course of blocks, their number, size and arrangement, and it also shows the manner in which pockets for the lower nuts of the anchor bolts were formed in the bottom of the foundation. The circles A, B, C and D indicate the location of the anchor bolts and also show the large washers which were placed upon the bolts to bear against the concrete foundation. These washers were supplemented with sheets of roofing tin which were slipped one over each anchor bolt through a hole made in each sheet of tin for that purpose. The tin was made to fit tightly to the large washer and to the bolt, and as the tin sheets were placed on top of the first course of blocks, and below the second course, the flow of concrete when the holes were being grouted was very effectually prevented, as far as leakage through the bottom of the foundation was concerned. Fig 3 shows the manner in which the pockets were covered; it also shows the small surface of pocket which is left unsupported



Figs. 6 and 7—Fifth and Sixth Courses.

by the first course of blocks. It further shows the washers in dotted lines, indicating that they are below the sheets of tin mentioned in the preceding paragraph. All through the foundation the anchor bolts project through the core holes which were molded in the blocks. No cores are shown in the first course of blocks. They were purposely omitted from the blocks, also in the second course all except the four core holes for the anchor bolts. This omission was made because some of the blocks had to bridge over the pockets, and necessarily were made solid for that reason. These two blocks were reinforced along their lower surfaces. One had several pieces of round iron (old bolts) laid into the mold close to the bottom. The other block contains two pieces of a broken grate bar which happened to be at hand. Cast iron is not usually considered desirable for reinforcing concrete, but that metal is sufficient for foundation work, as it is frequently used in brickwork to carry a wall across an opening. But cast iron must not be used when it will be subjected to much tensile strain. It is strong enough, but is treacherous. Some of the odd sizes of blocks in the second course could have been made with cores as well as not, for with the machines noted at the beginning of this article it is only necessary to leave the core out and place a bit of sheet iron temporarily over the core hole in the pallet while tamping is being done, in order to make the blocks solid at one or at both ends. Two machines were used as stated in making these blocks, one machine for the blocks 16 in. or less in length and another machine for blocks between 16 in .and 24 in., which is the limit of block length which can be made on these machines. And it is enough, for a block more than 24 in. long requires tackle for its handling in a foundation.

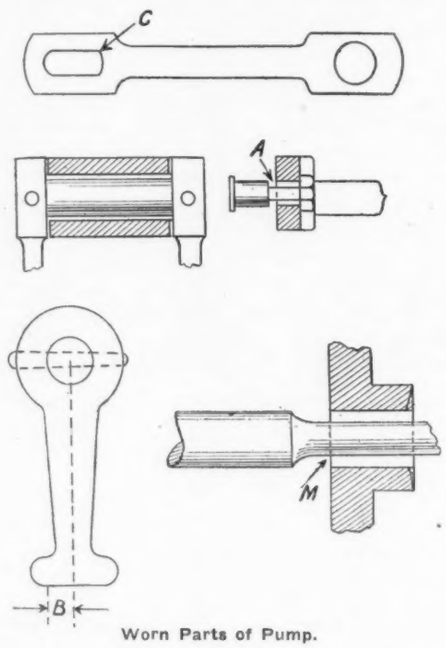
The 8-in. x 22-in. blocks were made in the 24-in. machine by simply placing a bit of 2-in. plank in one end of the machine during the tamping operation. The 12-in. x 20-in. block was made in the same manner, but with two 2-in. pieces of wood in the machine and with the 8-in. faceplate and end doors removed and 12-in. ones put on the machine in their stead in the second course (Fig. 3) all four of the 4-in. x 8-in. blocks were made at once by slipping thin partitions into the mold box of the machine. The third course of blocks, shown by Fig. 4, contains five standard blocks, two 24 in. and three 16 in. These are all made with full cores and this is desirable toward the top of the foundation, as it permits the formation of solid monolithic plugs or dowels in the core spaces, which effectively pin together each layer of the foundation and strengthen it beyond all requirements. It also finds a place for the large pebbles screened from the block material. The fourth course of blocks is composed of four similar shapes, all made in the 10-in. x 24-in. box of the 24-in. machine, a small box being nailed up of ⅞-in. stuff to fill one end of the mold up to the edge of the first core. This makes possible the novel and most excellent concrete key shown at *A*, also at *B* in the other pair of

blocks. The blocks being exactly similar, and cut off at the edge of the core, the monolithic sections *A* and *B* become virtual dovetails, which bind the blocks so firmly together that they would have to be destroyed before they would separate. As the grouted pebble filling also flows down into the third course, it will be seen that the whole foundation is bound together beyond the possibility of its ever coming to pieces. And in foundations where it was necessary some reinforcing slipped into the core holes before the coarse gravel and grout were put in place would fit the foundation for the most severe service that could be asked. The next course, which is the fifth or the one next to the top of the foundation, together with the top course, is made of standard 8-in. x 8-in. x 16-in. blocks. An inspection of the drawing will show that the monolithic core ties this course firmly to those beneath it, and that the joints are broken between this and the next lower course, as is the case with each pair of courses throughout the entire foundation. An inspection of Fig. 7 will show that the top course of blocks is similar to the fifth course, except that the blocks are all four arranged as stretchers instead of "Flemish bond," as in the fifth course. The arrangement of the cores being practically the same in both courses, the pebble grout will bind the four courses together. A novel and effectual way of finishing the top of this pier is to fill the core holes with pebbles and grout to within 1 in. of the top of the blocks, then put the pillow block in place, having it come about ½ in. or 1 in. above the surface of the blocks. Support the casting upon four pieces of iron or cubes of cement, and level and align it accurately and set the anchor bolts down to a fair bearing; then work thin 1 to 2 mortar under the pillow block until the cavity is full and all the air has been worked out. Then having plastered that portion of the foundation which shows around the pillow block, the job is finished. This foundation required the following blocks. One can estimate the time required for their making by comparison with a day's work for two men on 8-in. x 8-in. x 16-in. cored blocks, which is at least 200 in 10 hours, mixing the concrete by hand. The following is the schedule of blocks required: Four 8 in. x 4 in. x 8 in.; four 8 in. x 8 in. x 14 in.; eleven 8 in. x 8 in. x 16 in.; two 8 in. x 8 in. x 20 in.; four 8 in. x 8 in. x 22 in.; four 8 in. x 10 in. x 18 in.; two 8 in. x 12 in. x 14 in., and three 8 in. x 12 in. x 24 in., or a total of 34 blocks. As regards the strength of foundations made in this manner, the central or isolated station manager need have no fear whatever but that it will prove amply strong for the purpose. Fragments cut from blocks made from clean, coarse, gravel which would pass through a ¾-in. screen, together with the proper proportion of fine gravel and sand, mixed 1 to 5, as described elsewhere, tested up to a crushing strength of 2000 lb. to the inch when 14 days old. The mixture was graded as described by the writer in the Electrical World of Aug. 1, 1908. Eight per cent of water was used in the mixing, and the blocks were covered with wet sawdust and no water was applied further, except to keep the sawdust from drying out. Boards were laid upon the sawdust and a light sprinkling with a watering pot once a week for 4 weeks was all that was done to the blocks after they were removed from the pallets when 24 hours old. To determine the amount of material required for any concrete job, either for blocks, for monolithic work, to patch holes or to fill cavities, first determine the number of cubic feet or cubic yards to be filled with tamped material, then work under the supposition that concrete material shrinks 20 per cent during the mixing and tamping operations. This means that 5 cu. yd. of material will be necessary for 4 cu. yd. of finished concrete, with no allowance for waste. And there need be but very little waste if care be taken with the material. One bag of cement is supposed to contain 1 cu. ft. of that substance, and to weigh 100 lb. But it it is better to regard the sack as containing only 0.94 cu. ft. and weighing 95 lb., or 380 lb. to the barrel. The above will give 28.8 sacks of cement to a cu. yd. and require 5 cu. yd. of well-graded gravel, or 5⅜ sacks of cement to the cubic yard of gravel. Should the job require 4 cu. yd. of tamped concrete, there must be 20 per cent more material, or 5 cu. yd. of cement and gravel. The 1 to 5 mixture means that there are six parts, one of which is cement, the other five parts gravel. Then 1/6 of 5 cu. yd. equals 5/6 cu. yd., or just 24 sacks of cement. The gravel will be 5 x 5/6, equal to 4 1/6 cu. yd. of graded gravel. About 1100 lb. of water, or 134 gal., will be required for the concrete.

South Bend, Ind. James F. Hobart.

DEFECTIVE BOILER FEED PUMPS.

The accompanying illustrations serve to give an insight into the actual running conditions of a duplex boiler-feed pump. From observation one would judge that a duplex pump is expected to operate under almost any conditions and that accuracy in building and setting of the valves were of very little importance so far as operation was concerned. The pump had its cross rocker playing not less than 3/32 in. The long arm was loose and gave a 3/8-in. play at *B*, the pin having worn loose, which condition would dictate the employment of a solid arm construction. One of the small pins shown at *A* had not less than 3/32 in. play and was jumping from one side to the other. This was augmented by ⅛ in. play at *C* in one of the valve links with the same amount of play in the companion link. The



Worn Parts of Pump.

pump is operating with at least twice the play of the valve movement that was originally intended and yet it feeds a 300-hp boiler as though nothing were the matter with it. The rods are worn down as shown at *M* until the packing prevents the pump from making a full stroke. Of course no machinery should be permitted to operate in this condition. The loss of steam is enormous and the pump is likely to fail when most needed. The writer has observed many pumps operating, but none so bad as this one. Steam pumps are very often a source of great loss in power plants. They become leaky and give little or no external indication of the fact. Consequently much steam is permitted to go to waste and it is not unusual to find the auxiliaries requiring much more steam for their operation than the main units. An engineer troubled with pumps which knocked badly gave as the reason, too much air in the suction line; whereas the truth was that the pump was slipping due to leaky valves and a poorly packed plunger. Usually the excuse is given that there are no tools around the power house, but more often the fault is due to lack of ability or inclination to use what tools are available. Pumping machinery is not very efficient at best and it is very poor policy to let boiler-feeding apparatus run so long without attention that it is ready to fall to pieces.

Richmond, Va. C. R. McGahey.

QUESTIONS AND ANSWERS

By increasing the power factor from 60 per cent to 80 per cent, is there a financial gain for the generating station? If so, what is the proportionate gain, and how is it shown mathematically? E. D. S.

When the power-factor of a circuit is increased from 60 per cent to 80 per cent the generators are able to carry 33 per cent more load without increasing the current to any extent, and with an accompanying improvement in the voltage regulation. That is to say, the output of the station may be directly increased by 33 per cent. It is evident that this increase represents a clear gain in cases where no expenditure has been made in order to bring about the increase. In the November number there was published an article under the signature of Mr. John Liston in which these facts are discussed in greater detail.

On our system there is a 500-kw motor-generator set consisting of a three-phase induction machine and a compound-wound direct-current machine. This set is equipped with neither a power-factor indicator nor an indicating wattmeter. When it is being driven by the direct-current machine as a motor, is it correct to assume the output of the synchronous generator to be equal to $\sqrt{3}\,I\,E$ regardless of the power factor of other machines? A. D. S.

It is absolutely correct to state that an asynchronous generator can deliver only true power and that all wattless volt-amperes for the system must come from other machines. However, the observable volt-amperes of the asynchronous generator include not only the true power delivered by this machine, but also the wattless exciting volt-amperes delivered to this machine by the other machines connected to the system. It is evident, therefore, that the true power delivered is less than the total volt-amperes of the machine, which total is represented by the value $\sqrt{3}\,I\,E$ in a three-phase generator.

A ventilating fan requires a 4 hp to run it. Will it require more power, and how much more, if run by a 12.5-hp, 220-volt, 124-r.p.m. motor than if driven by a 10-hp, 220-volt, 1000-r.p.m. motor? Both motors are shunt-wound machines and the load is continuous during the day. T. E. Co.

A ventilating fan which requires 4 hp can be run by means of either a 10-hp or a 12.5-hp motor, but in either event the losses would be excessive, and it would be far preferable to use a smaller motor. At full load the efficiency of the 10-hp motor would probably be about 83 per cent, while that of the 12.5-hp motor would be perhaps 84 per cent. The full-load losses of the 10-hp motor would be 2.1 hp, while the full-load losses of the 12.5-hp motor would probably be 2.4. When running at a load of 4 hp the losses in the 10-hp motor would probably be 1.1 hp, while the losses in the 12.5-hp motor under the same conditions would be 1.3 hp. It will be noted that in either event the losses are excessive.

How can the "wave length" of a wireless station be calculated? What is meant by the inductance of a coil in centimeters? H. W. S.

In any circuit under resonating conditions, the frequency is such that the inductive reactance is equal to the condensive reactance. Thus, for resonance $L\,\omega = 1 \div C\,\omega$; where $\omega = 2\,\pi\,f$, f being the frequency in cycles per second. Therefore, $f = 1 \div (2\,\pi\,\sqrt{L\,C})$. With a velocity of propagation of V in any chosen unit length per second, the wave length would be $V \div f = 2\,\pi\,V\,\sqrt{L\,C}$ expressed in this same unit of length. The practical unit of inductance is the henry. The c. g. s. unit is called the "centimeter" because its dimensional formula happens to be identical with that for length; however, inductance is not a true length and cannot be measured in feet, meters or centimeters. There are 1,000,000,000 "centimeters" of inductance in one henry.

It is desired to run a 60-kw, 125-cycle machine during the day and a 105-kw, 125-cycle machine at night. Can two single-phase machines of this frequency be easily paralleled when changing from the light load to the evening load, each alternator being operated by a separate engine? H. W. P.

Alternators giving a frequency of 125 cycles can be so designed that they may be operated in parallel without difficulty. However, it is essential that the proper indicating devices be installed for showing when the alternators occupy the correct relative positions before the two machines are connected together. Almost any of the companies manufacturing alternators can supply devices for indicating the correct position for synchronizing. Synchronizing devices can also be made of ordinary incandescent lamps. It seems well in this connection to point out that where only two machines are used, and it is not the intention ever to employ them simultaneously for carrying the load, it is not essential to place the two machines in parallel; and, in fact, it may be far preferable to throw the load off from one machine and immediately onto the other machine during the light load period, rather than to risk certain difficulties incident to the parallel operation of the machines.

In what way may a wattmeter be used for measuring the wattless volt-amperes in an alternating-current circuit? D. A. S.

In a single-phase circuit, the wattless volt-amperes cannot readily be measured accurately; but a fair approximation to the true value can be obtained by substituting for the resistance in the shunt circuit of the instrument an equivalent inductive reactance built up without an iron core. This change is practically equivalent to reconstructing the meter and is not recommended. In a two-phase circuit, the value of the wattless volt-amperes is shown directly as the sum of the readings of the two meters when the shunt circuit of each meter is connected across the leads of the other phase from that in which its series coil is inserted. In a three-phase system operating with balanced load an indication of the wattless volt-amperes is obtained when the series coil of one wattmeter is inserted in one lead and the shunt circuit of the instrument is joined across between the other two leads. In this case, the reading of the meter must be multiplied by 1.73 to obtain the true value of the wattless volt-amperes. When two wattmeters are used for measuring the true power in a three-phase system, according to the usual method of connection, the difference in the readings of the two instruments, when multiplied by 1.73, will give the value of the wattless volt-amperes.

I have a fine wire of several thousand ohms resistance wound back and forth on a frame, so as to make the winding non-inductive. The spark from the secondary of an induction coil at the rate of about 200 per second seems to traverse the wire without very much resistance or self-induction. If the frequency is increased to 3000 sparks per second, will the self-induction be any greater than with the 200 sparks? Will this rule hold good with the same resistances if the wire is stretched out across the country several miles as a telegraph line using two wires, and would it make any difference if the ground is used as a return instead of the other wire? P. C. E.

What may properly be termed inductance of a wire is not appreciably altered when the frequency of the current is varied from 200 cycles per second to 3000 cycles. However, the effective resistance is changed enormously on account of what is called the skin effect. A current of high frequency penetrates into a wire to only a certain limited depth, depending upon the specific resistance of the wire and the magnetic properties of the metal. For example, in a copper conductor a frequency of 1,000,000 cycles per second will allow the current to penetrate to an effective depth of only 0.0064 cm. The depth of penetration varies inversely with the square root of the frequency. When the frequency is lowered to 10,000 cycles per second the penetration reaches a depth of 0.064 cm. At a frequency of 3000 cycles per second the depth of penetration would be slightly greater than 0.1 cm. The significance of this result is that a wire having a diameter greater than 0.2 cm acts as though it consisted of a hollow cylinder having a shell of 0.1 cm in thickness. When wires are stretched out across the country, as a telegraph line would be erected, then the effective reactance depends upon the ratio of the separation of the wires to the diameter of the wires, the formula being as follows:

$$L = 4\,l\left(\log \epsilon \frac{d}{r}\right) 10^{-9},$$

L being given in henrys; l, the length of line; r, the radius of wire, and d, the distance between wires, being expressed in centimeters; and ϵ being the base of the hyperbolic or Napierian system of logarithms, which is equal to 2.718. The ground can be used as a return circuit with only a slight increase in the value of the inductance and probably a decrease in the value of the resistance.

Central Station
Management, Policies and Commercial Methods

EXTENSION OF DENVER ORNAMENTAL STREET LIGHTING.

Arrangement has been made between the Business Men's Association of South Denver, the Denver Gas & Electric Company, the tramway company and Mayor Speer, of Denver, by which Broadway will be for over a mile lighted in a manner similar to Fifteenth, Sixteenth and Seventeenth streets, by ornamental steel trolley poles mounting arc lamps. The tramway sets the poles free, the city furnishes the lamps, the merchants pay two-thirds of the cost of the poles and the Denver Gas & Electric Company pays one-third of the cost.

TOASTERS AT FORTY CENTS A MONTH.

The Commonwealth Edison Company of Chicago is offering to its customers electric bread toasters on the payment of 40 cents a month for 12 months. The price to others than the customers of the company is $5.40 cash. The 40 cents a month will be added to each monthly lighting bill until the whole amount is paid. The customers desiring to avail themselves of this convenience are directed to call at the Electrical Shop, where the toaster is demonstrated every day and evening.

EFFECTIVE ELECTRICAL NEWSPAPER ADVERTISING.

The Cleveland (Ohio) Electrical Illuminating Company has, with the co-operation of other electrical interests in that city, inaugurated an effective system of publicity through a Cleveland daily newspaper. A full page is taken in the issue of every Saturday, part of which is occupied by electrical items interesting to the general reader, and the remainder by advertising announcements. A handsomely designed engraved head extends across the page, with the wording "The People's Electrical Page—Published Weekly." There are 11 advertisements in the issue of March 12, representing the central station, electric vehicle, electric wiring contractors, fixtures, motors, vacuum cleaners, etc. The advertisements are well designed, and the entire presentation is such that few readers will pass by this page, which makes a strong feature of the Saturday issue of the journal.

EXTINGUISHING ELECTRICAL FIRES.

From a paper on "Fire Protection," read by Mr. H. L. Gannett before the North Shore Electric Company Section of the N. E. L. A., the following information is culled:

In extinguishing electrical fires there is opportunity for the display of judgment and prompt action. The element of time is exceedingly important. The operator should observe whether conditions warrant the cutting off of current from the affected part before the flames are attacked. His knowledge of the apparatus under his charge should be such as to guide him properly. The use of the Babcock stream on live apparatus is not to be thought of, nor should it be thrown on burning free oil, as in both cases the probabilities are that an effect opposite to that desired would be produced. With a plentiful supply of sand and dry powder one should be able to quench fires which are not of such severity as would preclude their extinguishment by such material. Should a Babcock stream be necessary the current should be cut off of the affected part before the stream is applied.

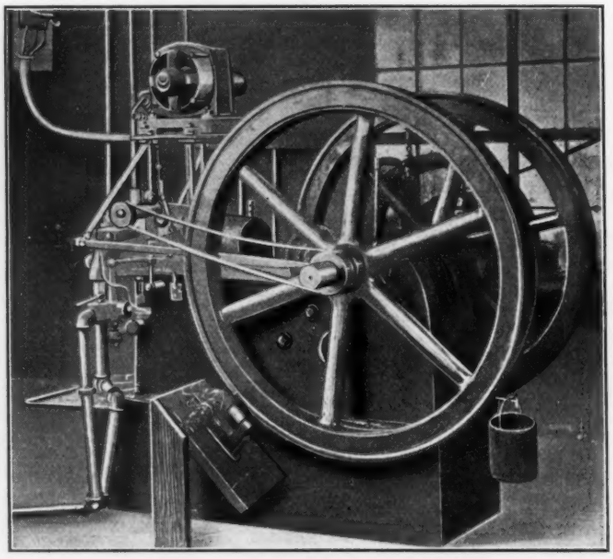
In an Edison substation recently, a starting compensator got in trouble through the short-circuiting of a coil. The shock was sufficient to throw out a coil and blow off the cover. The oil immediately ignited and burned with an intense heat. In attempting to extinguish the flames which were eating up on the leading-in cables, the operator tried quantities of sand with no effect other than raising the level of the oil. A Babcock stream was then tried, with no better effect. A wet "canvas tarpaulin" was then folded into five or six thicknesses and thrown over the top of the compensator with the result that the fire was smothered and extinguished. The burning cables were then extinguished with sand. We should have liked very much that dry powder had been used in this fire, as it would have furnished a severe test as to its merit.

ELECTRIC DRIVE VS. GAS ENGINE.

By J. E. North.

During the last five months the Springfield Light, Heat & Power Company, Springfield, Ohio, has made special efforts to take over gas-engine loads of various factories, and those efforts have been rewarded with an additional motor load of 120 hp. This connected load represents 244 hp in gas engines which have been removed, or are standing idle, in spite of the fact that the manufacturers get gas for 30 cents per 1000 cu. ft., and that there are seven gas-engine factories in Springfield, all controlled by local capital.

In negotiating for this class of business, it is very difficult to obtain actual costs of operating gas engines, and the average manufacturer can only see his power costs in his gas bills. Where conditions look favorable, a motor of sufficient capacity to carry the load of the gas engine and run the factory for 30 days is installed to let the manager, superintendent and foreman see the advantages of electric drive. We take all the



Electric Drive vs. Gas Engine.

responsibility of installing motor, providing pulleys and belts. If at the end of 30 days they do not desire to keep the motor, we ask them to pay us the actual amount that power would have cost them had they operated their gas-engine plant. We have made six such installations up to the present time, and have not removed a single motor; the manufacturer gladly pays for motor installation, etc., and signs a contract for a term of one to five years.

By the above plan, we have also shut down some steam plants, and our total connected load has increased 623 hp during the last six months.

One of our customers was honest and conscientious in regard to power cost, and mailed us the following letter on actual cost for gas-engine power:

"Confirming our conversation and complying with your request of recent date, I give the following information concerning our costs for power during the last year:

Cost of gas engine, new, rated at 12 hp	$400.00
Average cost per month for gas, oil, water and labor for starting, etc.	12.00
Amount of cash paid out each month for labor due to loss of time of employees	16.00
Cost of repairs for last year, average per month	3.00
Taxes per month	1.00
Interest and depreciation per month at 10 per cent	3.33
Total cost per month	$35.33

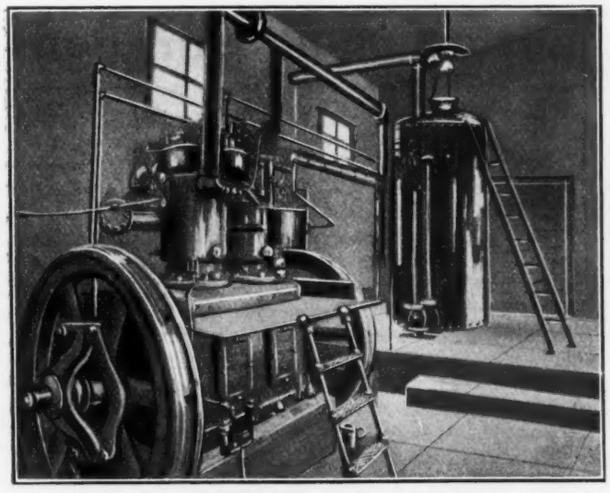
The above communication is from the J. N. Sterling Novelty Manufacturing Company. Under extreme conditions the power for the 5-hp motor, which replaces the gas engine, will not cost over $10 per month.

The accompanying photograph is being used to good advantage in showing prospective customers that the motor can be mounted where desired, and that the space occupied is a little more than that required by a gas-engine magneto. The illustration shows the scheme adopted by Mr. Sterling for mounting the 5-hp, three-phase, 220-volt motor on the cylinder of his 12-hp gas engine, and afforded us an advertisement.

A SUCCESSFUL GAS-PRODUCER SMALL CENTRAL-STATION PLANT.

Mr. L. A. Smelzer, of New Windsor, Md., sends us the following particulars of a 50-hp gas-producer plant which is being successfully operated by the New Windsor Electric Light & Water Company. The town has a population of about 500, and the central station supplies 47 60-cp street lamps and 27 houses, stores and hotels, the output averaging about 80 amp at 230 volts for six hours. Including stand-by losses, an average of only 200 lb. of coal is used per day.

The plant consists of a 50-hp Bruce-Macbeth gas engine and Smith gas producer, which apparatus has been found at least as reliable as any steam plant, there never having beeen the slightest trouble in operation. The engineer requires just 15 minutes to start the engine, 10 minutes to work the fire and five to blow it, and is then ready to pull the starting air lever. About 10 minutes are required to coal the producer and oil the engine. The speed regulation is well within the 2 per cent variation limit.



50-Hp Gas Producer Plant.

Our correspondent states that there is no question as to the reliability and continuity of service of the apparatus here used, though he is aware that some producer plants are found unsatisfactory, due in most cases to the inexperience of the operator. With a consumption of less than 1 lb. of coal per hp-hour and with no economizers, condensers and boilers to blow up, and no need of an expensive smoke stack, he inquires why the gas producer does not receive more attention from central stations. The small central stations in the country are, he adds, the ones that seem to be the most wasteful, especially where they have no use for exhaust steam, and in purchasing new equipment he considers that the gas producer should receive the most careful consideration.

ANOTHER PHASE OF THE TUNGSTEN SITUATION.

By Thomas E. Spence and J. E. Bullard.

For the last few years the central-station world has been greatly agitated over the tungsten-lamp situation. There, however, is one aspect of it which has evidently attracted little attention. That is to say, in order to make the best of the tungsten situation we must see to it that we keep the ratio in power load installed to lamps installed the same, or increase it in favor of power when we change to tungstens. To make this point plainer, suppose a station finds that during the past years for each horse-power in power connected they have connected 32 cp in lamps. If when a carbon installation is changed over they will leave the candle-power to horse-power in the same ratio and for every 50 watts removed add 30 watts in power, they will increase their revenue and raise their load factor.

Let us look at the conditions existing in one factory and see what we find. We will suppose this factory requires 100 hp and that it takes 200 16-cp lamps to light it. Of course, the lamps as a whole will be used but a few hours a day and the revenue per kilowatt installed will be lower on them per annum than on the motors in spite of the higher rate charged. To run this plant, then, it takes 74,600 watts in power, and reckoning 50 watts for each 16-cp lamp, it will take 10,000 watts to light it with carbon filaments. This makes the total maximum demand 84,600 watts for the 100 hp and the 200 16-cp lamps. Now, what will happen if we install tungstens in place of the carbons? We will then have 20 watts instead of 50 watts per 16 cp; or for the 200 16-cp a total of 4000 watts. This with the 100 hp will make the maximum demand 78,600 watts. Suppose we still keep the maximum demand the same—that is, 84,600 watts—and the ratio in light in candles and the power in horse-power the same. We find there are 6000 watts to spare. For each horse-power we must add 32 cp in light. That is, for each 746 watts in power added we must add 40 watts in light. Adding 746 to 40 we get 786. Dividing 6000 by 786 we get 7.63. That is, we can add 7.63 hp more in motors. In other words, without increasing the fixed charges or station capacity we can sell 107.63 hp in place of 100 hp where carbon lamps are used. In this case should we persuade the customer to install in tungstens the same wattage removed in carbons, the central station gains nothing and the customer is more than likely dissatisfied.

The average central station has been bending its efforts toward keeping the lighting load the same. If this has been done at the expense of power, a mistake has been made. Let us look at our example again. We have taken out 10,000 watts in light and replaced it with 4305.2 watts. The balance of the 10,000 watts we have added in power. It is physically impossible in the majority of cases to get a straight load curve, since for each horse-power added in power we must add a certain number of watts in light. For a few hours during the year the lights and power are on together. This combined load is what determines the size of the station.

The central-station situation as it stands to-day is very similar to the condition of many country roads. It is all hills and hollows. We are always going up hill or down hill. The best and cheapest way to level these roads is to pull down the hills to fill up the hollows. The only way a central station can be successful in getting a high load factor is to take business off the peak and distribute it over the low places. The tungsten lamp gives the new-business manager an unequaled opportunity to do this.

Since the advent of this highly efficient lamp practically every central station has increased and more highly organized the

lighting department, but not all of them have paid an equal amount of attention to the power department. The average lighting department as it exists to-day consists of specialists. There is a sign man, a window-lighting man, an outlining man and a large force of store, factory and residence lighting solicitors. Each and all of these men are helped out by the illuminating engineer. The duty of the illuminating engineer is ostensibly to give each customer the best light possible, but he too often spends all his time laying out tungsten installations which will consume as much energy as the old carbon one did.

The power department has in many cases not been increased. There are still the same solicitors, who receive little outside help, and who have not been increased in numbers in the same proportion that the lighting men have. In his wild scramble for the light watts, which are running away before the tungsten invasion, the new-business man has lost sight of his great opportunity to increase his load factor. If he would just sit down and do some figuring he would see that the revenue would be more largely increased if he would follow a different policy.

The aim of all new-business men should be to keep the ratio of horse-power to candle-power the same instead of keeping the ratio of watts in horse-power to watts in lighting the same. The question now arises: What is the best way to accomplish this end? The answer is: Pay more attention to the power department and specialize the same in the power department as in the lighting department. Have an industrial-heat man, and sell industrial heat on the power rates. As in the lighting department, have a specialist for each special class of business. You have an illuminating engineer in the lighting department, therefore have an industrial engineer in the power department.

To-day nearly everyone knows what an illuminating engineer is, but few have heard of an industrial engineer. For that reason we will endeavor to make it plain who he is, what he does and what he can accomplish. The industrial engineer is the man who fills one of the greatest needs of the central station. He should have a technical training along electrical and mechanical lines, practical shop experience and some past experience in selling. He does for the power department work very similar to that done by the illuminating engineer for the lighting department. He must be able to test a factory plant in such a way as to tell exactly the present operating expenses. He must be able to lay out the most economical motor installation. He must be able to make very close estimates on the cost of electrical operation. He does not solicit, but devotes all his time in giving practical and technical aid to the solicitor, both in the case of the new prospect and the old customer. He can get and give information which will result in landing the large and profitable prospects besides keeping the present consumers satisfied.

Too much stress cannot be laid on this exceptional opportunity open to the new-business man to increase his load factor. All that is necessary is to maintain the best ratio between the horse-power and the candle-power. Instead of trying to keep the ratio of watts in horse-power to watts in lighting the same, endeavor to increase the horse-power output each time you change a carbon installation. In other words, please the customer by reducing his bill, but sell the capacity released for 10 hours a day to some power user.

HANDLING TUNGSTEN LAMPS.

The National Electric Light Association *Bulletin* for March contains some information of interest on the handling of tungsten lamps. This has been compiled by Mr. H. B. Gear, of the Commonwealth Edison Company, for the lamp committee, and although it is written from the viewpoint of the large central stations, small central stations can doubtless adapt it to their needs.

Where the first installation of carbon lamps and renewals are furnished free, tungsten lamps may be furnished at a reduction of from 5 cents to 10 cents below company cost, to give the customer the benefit of the carbon lamp which he would otherwise have used. It seems wise not to allow the consumer the full benefit of the price of the carbon lamp, as the percentage of breakage of tungsten lamps is higher than with carbon lamps, as well as the unit cost of the lamps themselves. For instance, if a group of customers uses 1000 tungsten lamps during a stated period in place of 1000 carbon lamps, the loss by breakage might be about 5 per cent, or 50 lamps. Assuming that the tungsten lamps were distributed between the 25-watt, 40-watt and 60-watt sizes, the average cost of broken lamps would be perhaps 60 cents. The value of the 50 lamps would therefore be about $30. This is equivalent to an extra cost of 3 cents per lamp on 1000 lamps, and must therefore be considered in fixing the amount which the customer is to be allowed, in view of the fact that he does not use carbon lamps.

Actual experience in handling the tungsten lamps in large quantities indicates that the total breakage in shipment from the factory to the company's storeroom and delivery from the storeroom to the customer's premises by messenger, does not greatly exceed 5 per cent. The process of transportation from the company's storeroom to the consumer's premises is a difficult one, and is necessarily expensive. Tungsten lamps may be delivered in the original packages by wagon, where they are required in standard package quantities, with reasonable success. After they are delivered to the premises, however, they must be unpacked and placed in the sockets by experienced men.

In handling the calls for lamps in small quantities from all parts of the city the most practical method seems to be to provide carrying cases which men can take in their hands on a street car or on foot, answering a number of calls on one trip. About 800 to 1000 calls per week, aggregating from 5000 to 6000 lamps of all sizes, are handled in this way in Chicago at an expense of about 3½ cents per lamp for labor and transportation.

This is considerably greater than the cost of delivering carbon lamp renewals by delivery wagon, on account of the fact that the calls are widely scattered; and the messenger installs the lamps in the customer's sockets in order to be sure that the lamp is left in good operating condition. The average number of calls made by messengers in outlying parts of Chicago is about 10 per day, the down-town messenger making from 14 to 16 calls per day. The average number of lamps delivered per call is between five and six.

Wiring and Illumination

ILLUMINATION OF A TURBINE PLANT.

A feature of the new turbine station of the Fall River Electric Light Company, which was described in these columns at the time of its completion, is the illumination of the machinery room. The turbo-alternators and principal auxiliary equipment are located in a room 112 ft. long by 43 ft. wide, the height from the floor to the roof girders being 53 ft. The turbine room is lighted by 56 100-watt clear tungsten lamps equipped with concentrating reflectors attached directly to the roof girders. The lamps are hung in rows of eight, spaced 5 ft. apart on the girders, the end lamps of each row being 6 ft. 6 in. from the side walls. The girders are 14 ft. apart, and the lamps are wired with steel conduit and condulet outlets, the switches controlling every other line across the room. The side walls are of a dull red color. Upon completion of the installation an illuminometer test was made which showed an average intensity of 1.68 ft.-candles upon a test plane 30 in. above the floor, with an energy expenditure of 1.17 watts per square foot. The average lumens per watt were 1.44. Owing to the interference of the large turbine and other machinery, it was impracticable to locate the illuminometer test stations over an even quarter of the space, but so far as possible the latter were located at centers of 5-ft. squares. The individual measurements of foot-candles varied from 1.12 to 2.13. The height of the lighting units gives excellent diffusion and practically eliminates shadows. Local lighting is unnecessary around the machinery.

THE CHICAGO HOUSE-WIRING CAMPAIGN.

At the regular monthly meeting of the contract department of the Commonwealth Edison Company, Chicago, on March 8, several men employed in the house-wiring division of the contract department gave brief papers, illustrated in some cases by lantern-slide pictures, on various aspects of house wiring, based on the company's house-wiring campaign. This is a practical subject which is always important to central-station men, and the various points brought out by the speakers were listened to with attention by the other members of the contract department. Abstracts of the four papers presented are given herewith.

ELECTRICAL CONVENIENCES FOR THE HOME.

The responsibility for the proper location of outlets and switches, as well as the method of controlling the lamps, usually rests on the company when a prospective customer has decided to equip his residence for electrical conveniences. Taking as an example a standard eight-room or nine-room two-story frame house, with attic and basement, the speaker outlined a plan for the necessary wiring and appurtenances. In the attic a drop lamp may be installed, and it may be controlled by a switch at the foot of the stairs in the second-floor hall. It is sometimes advisable, however, to provide an additional circuit, terminating the wires at an outlet or junction box in the attic for future use, in case the owner contemplates finishing off this part of the house for rooms.

The principal bedroom should have a bracket lamp each side of the dresser and a ceiling fixture controlled by a convenient wall switch located on the left-hand side of the door, if possible. For the smaller bedrooms a single bracket or ceiling lamp is generally sufficient, the fixture being equipped with a pull chain socket. A three-way switch placed on the wall at the head of the bed, within easy reach of the hand, is a great convenience, as it enables the occupant of the room to turn on the light should he want it suddenly in the night. Much the same plan may be followed in the bathroom as in the small bedrooms, although a single lamp on a goose-neck fixture above the mirror is sometimes preferred to a pendant fixture hung from the ceiling at a level of about 6 ft. 3 in. from the floor and about 1 ft. from the glass. Fixtures and switch plates here should be finished in nickel. Baseboard outlets should be provided where necessary for use with heating pads, hot-water heaters, electric shaving mugs, etc.

The switching on of the lamp from the bed, as previously mentioned, may be extended as an emergency burglar system. The idea is to install near the owner's bed a master switch, the turning of which will light enough fixtures distributed around the house so as to give a general illumination. The use of a three-way switch controlling each individual fixture, on this system, makes it possible to operate these fixtures in this manner, but it is to be remembered that when the master switch is turned on the lamps at the individual fixtures cannot be turned off by their respective switches.

For the control of a ceiling fixture in the first-floor hall and a bracket fixture in the second-floor hall four three-way switches, two in each hall, are recommended. This arrangement enables the owner to control the light from upstairs or downstairs, individually or together. If desired, these lamps may be also operated in connection with the emergency system.

All clothes-closets, unless very small, should be equipped either with drop lamps or pull-chain wall sockets, with a wall switch or automatic door switch installed for their control.

Where three main rooms—living-room, library and dining-room—are of good size, a number of conveniences may be installed. Baseboard outlets may be located in convenient places to allow the connection of portable lamps and fans or cooking appliances in the dining-room, while in the library, if the table stands near the center of the room, a flush receptacle may be installed in the hardwood floor for connection with a reading lamp. Flush wall receptacles controlled by switches will serve as a source from which paintings and portraits may be lighted by picture reflectors.

If the two points of entrance to the room are some distance apart, it may be desirable to control the center or bracket lamps by a three-way switch at each of the entrances. This has been found especially convenient in the dining-room, as it obviates the necessity for the maid crossing the room in order to turn the light on or off. Indirect lighting may often be used to advantage in these rooms. A center lamp close to the ceiling, with a distributing shade and tungsten lamp operated by a switch near the door, gives the best results in the kitchen, provided the walls are painted white. Baseboard and wall outlets may be used for electric flatirons or other appliances, although in most cases a separate circuit is run to the kitchen, where a switch and receptacle are installed under one common plate. In this way the lamps are not affected by low pressure if the flatiron is being used at night. Where the owner is willing to go to this small additional expense, it is much better to wire outlets for this special service on a separate circuit.

Much the same arrangement may be made in the laundry with an outlet for the washing machine. A switch should be installed at the head of the basement stairs to operate a drop lamp near the bottom landing. Drop lamps should also be placed in the basement wherever necessary. Porch lamps should be provided and may be located either on the ceiling or on the side near the door with a switch placed in the first-floor hall.

Small tungsten lamps of 12 cp or 16 cp and designed for 58 volts to 60 volts may be arranged on an alternating-current system in connection with a small compensator coil installed on the mains to take care of the unbalance in the load or wired two in series on 110-volt, direct current on fixtures. In planning the wiring, additional appliances, such as vacuum cleaners, sewing-machine motors and the like should be taken into consideration in order that the installation may be complete.

HOUSE-WIRING PROPOSITION.

Remarking that the liberal offer of the Commonwealth Edison Company to owners of completed houses and apartments not wired for electricity had made possible the use of the electrical conveniences described in the preceding paper, the second speaker gave a synopsis of the company's proposition for wiring houses. The prices for this work are figured from schedules covering five different classes of residence and apartments, the cost without interest being spread over a period of two years and divided into 24 equal consecutive monthly installments, the first payment being made upon signing the wiring contract. Fixtures, either combination or straight electric, are selected by the customer at the showroom of a Chicago dealer in fixtures and are paid for on the same basis as the wiring, a separate contract being made for the fixtures. Only the signature of the person or persons owning the property is accepted on one of these contracts, so that if a tenant wishes to have a house wired, he must arrange with his landlord. If service is not available, the prospective customer is as liberty to have his house wired on a cash basis, with the understanding that electricity will not be furnished until some future time.

Overhead service from the company's existing mains is brought to the building without additional cost to the consumer and where the lines are underground in the rear a pole is set on the customer's premises from which the wires are run in overhead from the underground connection; if a stable or garage stands on the rear of the lot, the pole is not needed. If service is installed underground from the building line, $1.25 a foot for the first 15 ft. is charged and $1 for each additional foot. This wiring proposition is extensively advertised, and over 4500 requests for estimates have been received up to the present time. About 10 per cent of these, however, would require line extensions not approved by the company. A large proportion of these inquiries were followed up and contracts secured. Still, considerable house wiring is done by other contractors, and it is believed that in these cases also the proposition of the Commonwealth Company has often brought the subject to the attention of the householder. Wiring for three or four lamps or for a few additional lamps in a home is not taken on this basis, and only in cases where the whole house or the first or second floor is to be wired are the time payments allowed. The above plan of payment does not apply to residences in process of construction nor to business establishments.

It is amusing to note the impatience with which some customers await the coming of the wiremen, although having waited years before attempting to make the improvement. It usually takes from four to five days after the contract is signed before the wiring is commenced. Fixtures have to be made up

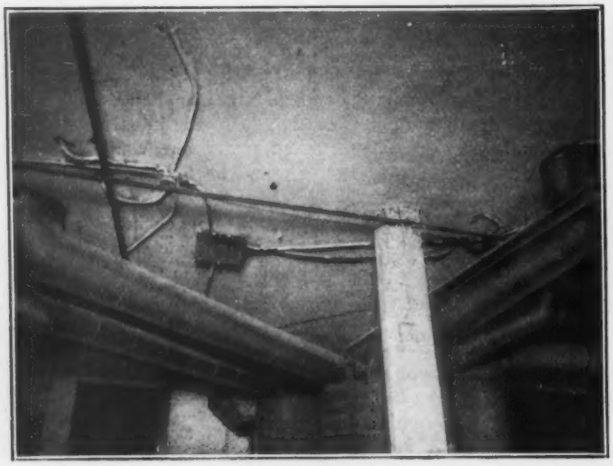


Fig. 1—Distribution Cabinet and Two Junction Boxes on Ceiling of Basement.

and are usually delivered on the job complete within two or two and one-half weeks from the date of placing the order.

HOW THE WIRING IS INSTALLED.

The company has an especially selected force of wiremen whose experience is quite an asset in these special house-wiring propositions. All wires above the basement are concealed in Greenfield flexible steel conduit, or B-X cable, beneath the walls, while in the basement of houses the conduits are run exposed on the ceiling. The use of Greenfield conduit is preferable for concealed work, for the reason that if any future trouble should occur in the circuits, making necessary the withdrawing of the wires, the latter may be pulled out easily, while with B-X cable this cannot be done, as the wires are held firm in the conduit.

Generally the first operation of the wiremen is to cut openings for the ceiling bracket and switch outlets at the locations designated by the occupant, although it is not always convenient to place them exactly as suggested. Where an attic is not available an opening is made in one of the clothes-closets for which

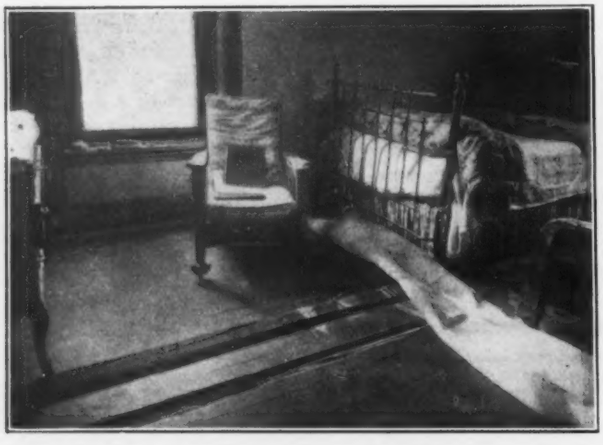


Fig. 2—Laying Conduit in Floor of Bedroom.

a trap door is afterward furnished. The conduits are carefully fished between the studding under the plaster or laid in the floors, a flexible steel tape being used at times, previous to the pulling in of the conduit. With this tape a wireman is able to feel his way from outlet to outlet without danger of breaking the plaster, beside ascertaining whether his progress is impeded by a cross-piece of timber.

Metal boxes are installed at each outlet flush with the wall and fastened to the studding with screws. Supports are provided for straight electric ceiling outlets, as the weight of the

Fig. 3—Laying Conduit in Floor of Bedroom.

fixture, which is screwed to the fixture stud, is dependent upon this outlet box. In the case of combination outlets the gas pipe serves as a support. All wall switches are of the flush push button type, the plates being usually finished in brushed brass.

Fig. 1 shows a distributing cabinet placed on the ceiling in the center of the basement of the house. From this cabinet conduits are run exposed to two junction boxes. From these boxes the conduits are continued to various outlets above. The cabinet is usually placed on the side wall, but in this instance the ceiling was low enough to permit the inspector reaching it from the floor. The service switch, cabinet and the meter are in the rear end of the basement in the laundry behind the wall shown in the picture.

Fig. 2 gives an idea of the manner in which the floor is taken up for the placing of the Greenfield conduit. The picture shows a bedroom above the dining-room. Fig. 3 is a picture taken in the same room from a different position. All the flooring and the woodwork are placed in good condition by the company's carpenter working on the job. But although the wiremen proceed with care, the company does not hold itself re-

Fig. 4—Bedroom Before Wiremen Entered.

sponsible for patching up plaster nor retouching the decorations. However, work of this kind is rarely found necessary. Fig. 4 shows a bedroom interior before the wiremen began their work. Fig. 5 is a picture of the same room with two wall outlets at each side of the dresser position ready for the

attachment of combination brackets. Fifteen minutes' time was consumed in cutting these outlets in the wall. This included taking off the two gas brackets shown in Fig. 4, capping the ends of the gas pipe, sawing away a portion of the lath, setting the boxes flush, securing them with screws and screwing bushings on the end of the Greenfield conduit. Previous to this, however, the conduit had been installed at these locations on the other side of the wall which was opened. Some of the tools used are shown in Fig. 5. The picture also shows the "drop cloth" on the floor tacked to the baseboard to receive bits of plaster and other debris caused by the work. These

Fig. 5—Same Bedroom as in Fig. 4, With Two Side Outlets.

cloths are used in all of the company's residence wiring jobs. When a room is finished it is left in nearly the same condition as when entered and any small bits of refuse not caught with the cloth are brushed up.

Sometimes a switch and receptacle under a common plate are wired on a separate circuit for use in connection with electric flatirons and the like. The price for wiring this connection complete is $8 if the outlet is placed on the first floor and $10 on the second floor—that is, if included in the house-wiring contract.

RESULTS OF THE HOUSE-WIRING CAMPAIGN.

Mr. A. J. Kay concluded the symposium by a résumé of the Commonwealth Edison Company's house-wiring campaign. From Aug. 22, 1907, to Feb. 26, 1910, the total number of contracts secured was 1393, representing 39,787 16-cp lamps. The total amount of construction business represented by these contracts was $218,682.

Fig. 6 is a map which gives an idea of the thorough manner in which the city is covered during this campaign. Contracts have been secured as far north as Howard Avenue (city limits) and as far south as 133d Street. By referring to this map it will be noticed that in several cases there are clusters or groups of houses in the same locality, which would seem to show that one customer calls the improvement to the attention of his neighbors and so brings others.

Fig. 7 consists of curves showing the development from

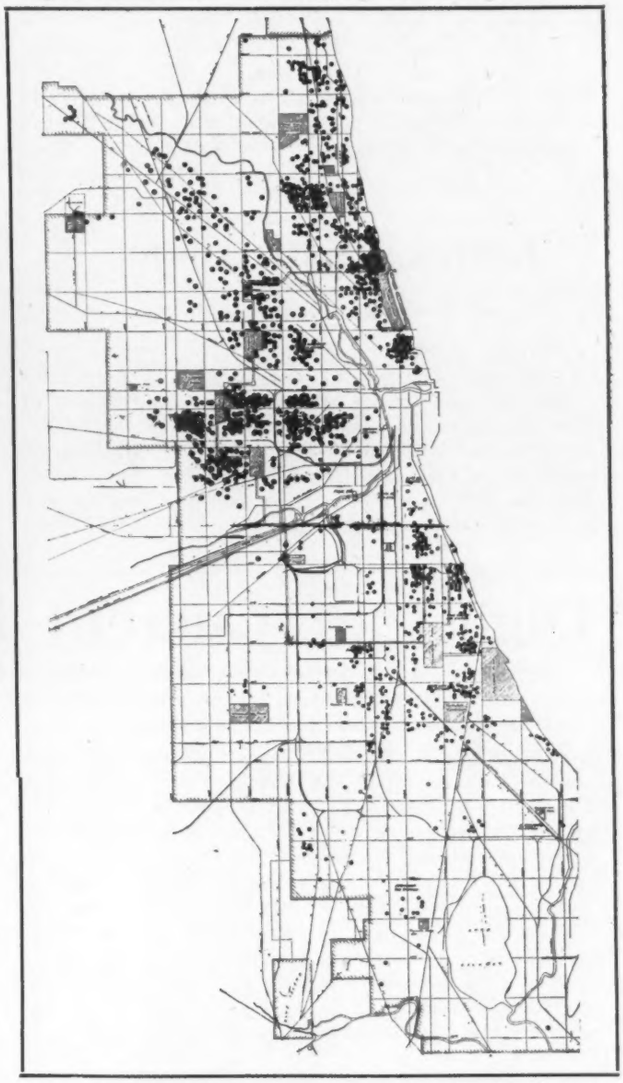


Fig. 6—Map Showing Location of Houses and Apartments Wired in Chicago.

August, 1907, up to about the present time. During the four and one-half months in 1907 4023 lamps are contracted for; in 1908 the number was 11,861 and in 1909 20,831. For the months

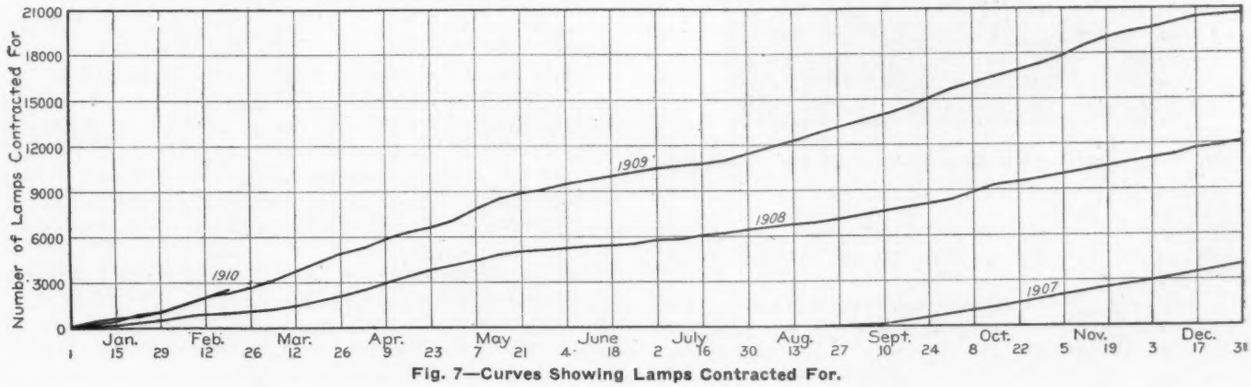


Fig. 7—Curves Showing Lamps Contracted For.

of January and February, 1910, wiring contracts representing 2708 lamps have been executed.

The cost of wiring complete with fixtures is from $7 to $9 per lamp on the average, depending upon the class of residence, house or apartment. It usually takes about 2½ days to wire a

cottage, from 4 to 5½ days for a two-story apartment building or a two-story house, and 10 days to 2 weeks for large residences and apartments. Naturally, however, the time for this work depends in a large measure upon the number of wiremen assigned to the job. After the contract work is completed, a letter is sent to the customer asking if everything is satisfactory. The company has received answers to many of these inquiries and has on file a number of responses in which the customers speak highly of the work performed. These letters are of assistance in the securing of new business of this character.

Letter to the Editor.

The Test of Turbine Alternators.

To the Editor of Electrical World:

Sir:—In your issue for March 3, Mr. W. V. Lyon takes exception to several points in my article on the testing of turbine alternators which appeared in the issue for Feb. 3. It should be explained that the reason for short-circuiting the ammeter is that the heavy inductive discharge occasioned by opening the field circuit of a large generator sets up very high potential strains which may puncture the insulation of the meter-coils. Those who have been accustomed to the operation of large generators can appreciate the severity of the strain set up because the voltage is sometimes sufficient to puncture the field coils themselves. It would be better to remove the meter entirely from the circuit, but in case of an emergency a tester would not have time to do so, while it would require only an instant to close the meter short-circuiting switch.

The method of determining the regulation described conforms to the standarization rules of the American Institute of Electrical Engineers. Rule 192 states that: "In constant-potential machines, the regulation is the ratio of the maximum difference of terminal voltage from the rated-load value (occurring within the range from rated-load to open circuit), to the rated-load terminal voltage." Rule 205 states that regulation is understood to refer to non-inductive load, except where expressly specified otherwise. Reading from the saturation-curve the voltage corresponding to full-load field current amounts to the same thing as applying full-load to the generator, adjusting the field current to give the rated volts, then throwing off the load and reading the no-load volts. The difference between these two voltages, divided by the rated voltage, is the regulation according to the practice recommended by the standardization rules.

Kenyon, R. I. Howard M. Nichols.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Turbo Field Magnets.—Miles Walker.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. on the design of turbo field magnets for alternating-current generators. The paper, which is mainly concerned with large units at high speeds and a rotary field magnet, reopens the controversy between the projecting pole type of field magnet and the slot type. Reasons are given why the latter type is better suited for obtaining the greatest possible output from a given diameter. The advantage of the slot type with distributing winding is that by placing the winding in slots between iron teeth a greater part of the periphery can be utilized both for carrying flux and for carrying amp-turns. In order to obtain a generator of good regulation, it

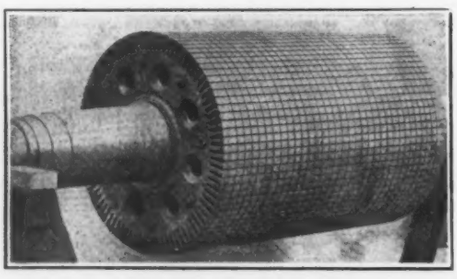


Fig. 1—Cylindrical Field Magnet Arranged for Distributed Winding.

is necessary to have the amp-turns at no load upon the field magnet greater than the amp-turns on the armature. Where the iron body of the pole and the iron core of the armature offer very little magnetic reluctance, it is necessary to introduce into the magnetic circuit some part, such as a large air-gap, which will offer a large reluctance, and enable the amp-turns on the field magnet at no load to be of the required amount. It is, therefore, seen that the interference with the magnetic circuit caused by the slots in Fig. 1 is rather beneficial than otherwise, for the flux path being constricted in these teeth, there is a drop in magnetic potential just as there is in an air-gap. Again, the space taken up by the teeth does not seriously interfere with the space required for the copper, because the iron presents a large surface to which heat can be conducted from the copper, and in that way enables the copper to be worked at a higher current density than otherwise would be the case. Thus the iron and copper, though each, to a certain extent, encroaches upon the space required for the other, mutually assist one another. It will be seen, too, in Fig. 1, that the iron below the slots offers such a large cross-section for the flux path that space can easily be spared for a number of large holes which traverse the field magnet from one end to the other, and supply air to a number of radial air ducts. It is found in practice that copper placed in such slots can carry twice as many amp-turns per square inch as copper in a wound coil 2.5 in. thick. The author discusses the methods adopted by various makers for supporting the windings, and considers the possible limits of output.—Lond. *Electrician,* March 18.

Short-Circuiting of Generators.—M. Walker.—The conclusion of his paper presented to the (Brit.) Inst. Elec. Eng. on short-circuiting of large electric generators and the resulting forces on armature windings. Oscillographs are given showing the current on short-circuit and voltage rise across the circuit-beaker.—Lond. *Electrician,* March 18.

Voltage Drop in Transformers.—A Blondel.—An article illustrated by diagrams on a simple graphical method for determining the voltage drop of transformers. As in the case of transmission lines, the author shows that the system of circles which represents the solution of the two fundamental problems (determination of the voltage drop for constant primary voltage and for constant secondary voltage) can be used independently of the rest of the diagram and with the aid of a simple auxiliary the results may be read off directly.—*La Lumière Elec.,* March 12.

Magnetic Properties of Steel.—C. F. Burgess and J. Aston.—An article on the magnetic properties of electrolytic iron and some commercial steels. The results are given in diagrams and tables. The following general conclusions are pointed out. The refining of commercial steels results in improvement of the magnetic qualities. The amounts of impurities met with in commercial practice do not result in a serious deterioration of the quality. Judicious heat treatment and mechanical treatment has an importance equal to that of chemical composition, and proper annealing undoubtedly results in marked improvement in the magnetic quality.—*Met. and Chem. Eng'ing,* April.

Lamps and Lighting.

Candle-Power and Energy Consumption of Incandescent Lamps.—R. VON KOCH.—An article on the light sensitivity of the human eye when the current supplied to an incandescent lamp is varied. The experiments of the author show that the candle-power of incandescent lamps at different temperatures of the filament follows the law

$$cp = C \times (100\,i)^{8.7} \text{ hefner candles}$$

within the ranges of temperature investigated; these were from 1300 deg. C. to 1700 deg. C. for the carbon lamp and from 1500 deg. C. to 1900 deg. C. for the osmium lamp. C is a constant which depends on the filament, and is about 8 for the carbon lamps and 10 for the osmium lamps tested by the author. The candle-power changes, therefore, as the 1.85th power of the watts.—*Phys. Zeit.,* March 15.

Temperature and Voltage of Arc.—C. D. CHILD.—The theory of the electric arc, as at present held, leads one to expect that with cooled electrodes a higher potential difference will be needed to maintain the arc than with electrodes not cooled, but the experimental evidence to a large extent favors the opposite view. The author has repeated a few of the experiments made by others for the purpose of finding the effect on the electric arc produced by cooling the electrodes. These results show that cooling the cathode of a carbon arc raised the voltage when the anode was cooled. The anode and cathode drops were measured and both were found to increase when the cathode was cooled, the principal increase being in the anode drop. The increase in the potential in different parts of the arc was approximately proportional to the potential existing before the cathode was cooled.—*Phys. Rev.,* March.

Horizontal Illumination.—P. HOEGNER.—The conclusion of this illustrated article on a new method for calculating the horizontal illumination of streets and squares. In the first part the author discussed a new method of determining the mean horizontal illumination and he now takes up a method for calculating the maximum and minimum horizontal illumination. Some numerical examples are also given.—*Elek. Zeit.,* March 17.

Generation, Transmission and Distribution.

Electric Power from Blast-Furnace Gases and Cost of Energy.—I. V. ROBINSON.—A paper read before the West of Scotland Iron and Steel Institute. With special reference to Glasgow. The author showed that blast furnace gases, as far as they are not needed in the blast furnace itself, could be usefully employed for the generation of electric energy to be distributed over the neighboring territory. He stated that in a gas-engine station using blast furnace gas, an electric hp-year can be generated at a total cost of about $11.25. To this has to be added the profit, which is assumed as 10 per cent of the capital cost of the plant, or $6 per hp-year. This item may be regarded as the cash value of the energy produced from the gas and is equivalent to 0.088 cent per kw-hour generated, assuming a 100 per cent load factor. Allowing for 5 per cent of the energy being used in the power station, the sale price at the power station will be $18.20 per electric hp-year. In an appendix to his paper it is stated that the works costs for the Glasgow Corporation Electricity Department for the year ending May 31, 1909, were: Fuel, 0.50 cent per kw-hour; oil, 0.04 cent; wages, 0.20 cent; repairs, 0.10 cent, making a total of 0.84 cent per kw-hour. The total output was 32,736,058 kw-hours and the average load factor of the station was 18.35 per cent. Correcting the various items for the difference between load factors of 100 per cent and 18.35 per cent, it was assumed that the fuel used per unit would be reduced in the ratio of 1.298 to 1.00; the cost of repairs and of oil would probably be three times as much as for the 18.35 per cent load factor, and the total cost of wages per annum would be increased by 20 per cent. The total cost per kw-hour sold would then be 0.5060 cent, equivalent to a total cost of $34.40 for electric hp-year. At the Glasgow Corporation tramways department power station the total works cost is 0.70 cent per kw-hour; the output is 25,944,101 kw-hours, and the load factor 37.5 per cent. Dealing with the various items, as before, the wages are increased 10 per cent, the oil 47 per cent, the repairs 47 per cent, and the fuel has been decreased in the ratio of 1.184 to 1.00. With these corrections, the total cost works out at 0.4514 cent per kw-hour, or $31 per hp-year. By taking the lowest recorded cost for each item in any British power station, and correcting the amount for a 100 per cent load factor, the following figures are obtained: Fuel, 0.2692 cent; oil, 0.0110 cent; wages, 0.0204 cent; repairs, 0.0550 cent, making a total of 0.3556 cent per kw-hour. This amounts to $24.20 per hp-year. This figure is then the lowest at which energy could be generated in the average modern station, while with blast furnace gas stations the cost per hp-year would be $11.25. In the discussion W. W. Lackie disagreed with the author entirely and thought that bringing the costs to a common load factor of 100 per cent led to several erroneous conclusions. J. H. Heap thought that for the use of the electrical energy generated from blast-furnace gas a field is to be developed in electric steel making. Dumby said that the public supply of electricity from blast-furnace gas power was by no means an ideal proposal, the average load being only 25 per cent of the maximum. It was an absolute necessity for the satisfactory utilization of the gas that the electrical power should be required very nearly throughout the 24 hours, and for seven days a week, in order to get anything like full interest out of the capital expenditure, and that narrowed the field of use very much. A great field would in the future be open to electrometallurgy.—Lond. *Elec. Rev.,* March 18.

Traction.

Three-Phase Traction.—C. L. DEMURALT.—The first part of a serial in which the author explains why he believes in the three-phase system for electric traction on trunk railways. One of the principal advantages is, in his opinion, the constant-speed characteristic of the three-phase locomotive. This permits strict adherence to the time schedule, it also requires the minimum headway between trains. As to the disadvantage that has been claimed, namely, that the three-phase system cannot make up lost time, he says that this could readily be done simply by inserting resistance in the motor when running down grade. But he does not recommend this since he does not want to give the engineer a chance to run above normal maximum speed. As a matter of fact, engine men make up time almost entirely by the practice of cutting down the time of coasting and by prolonging the period of full-speed running as much as possible. This can be done equally well or better with the three-phase system. In high-speed elevator service constant-speed motors are always used in spite of the frequent stops; he concludes that they will be the more dependable for trunk-line service.—*Elec. Trunk Line Age,* February.

Electrification of Steam Railroads.—A full account of the recent discussion at the New York Railway Club of the report of the committee on the electrification of steam railroads.—*Elec. Rail. Journ.,* March 26.

Installations, Systems and Appliances.

Direct Current Versus Three-Phase Currents.—W. WUNDER.—In an estimate for a city of 100,000 inhabitants the author finds that it is much more economical to supply the suburbs with three-phase currents instead of erecting converter stations for supplying them with direct current. The first costs and the energy loss are about one-third less than with direct current. The difference in the economy is so considerable that even in cities of other size the supply of the suburbs with three-phase currents offers economical advantages over direct-current supply. The saving in first cost is of special importance, since it is known by experience that it takes much longer time to develop a load in the suburbs than in the center of the city and, therefore, the cable network will be worked below its normal load for a long period of time.—*Elek. Zeit.,* March 17.

Ignition of Coal Dust by Electric Flashes.—W. M. THORNTON.—An abstract of a lecture held before the (Brit.) Inst. Elec. Eng. in New Castle. In the experiments dust was used which had not been specially prepared, but had been taken off the timber in a colliery. Dry coal dust is a perfect insulator; also,

contrary to the general belief, solid coal is a very much better insulator than stone. On the other hand wet coal dust and dry coke dust are conductors. Wet coal dust is effected much more rapidly by alternating than by direct current. The author discussed at length the effect of flashes due to fuse blowing. He recommended that distribution fuse boxes, in which the opposite poles were separated by an insulating shield only, should always be arranged with the busbars at the bottom, as there was thus much less chance of an arc being started inside the box in the event of the fillet being broken and the box becoming partly filled with metallic vapor due to a fuse blowing. The author then carried out a number of experiments with the aid of an apparatus consisting of a box in which a fuse could be blown and also fitted with a quick-break switch operated from the outside. Leading into the box was a short length of glass tubing, about 2.25 in. in diameter, to the outer end of which an arrangement was fitted by means of which coal dust could be blown into the box. From the other side of the box a similar but much longer glass tube projected. When the dust ignited in the box the resulting flame was seen to travel along the longer tube, and the violence of the explosion could be gaged from the length of the flame. As the result of a series of experiments made with this apparatus with a gradually increased current he found that the number of ignitions as percentage of the numbers of trials was proportional to the current employed minus a constant current (which would represent the minimum current capable of producing an explosion). From the aspect of dust explosion alternating currents seems to be approximately twice as safe as direct current. When blowing fuses in a cloud of dust it was found that with low-pressure current, say, of 480 volts, an excess over and above that required to blow the fuse had a considerable influence on the percentage of explosions, but with higher voltages no excess was necessary, as an explosion could be produced with certainty with the minimum current required to blow the fuse. Regarding the influence of the amount of power behind the flash it was found that on a 100-volt circuit 5 kw was the value below which an explosion could not be produced. Very violent explosions can be obtained w th flour. In the discussion Clothier pointed out the great danger from the presence of gas. Many coal-dust explosions are initiated by small gas explosions. He showed two boxes, one having the ordinary rubber gasket between the box and the lid and of the type usually called gastight, but the rubber ring was very liable to damage, and then the box became a source of danger. He filled the box with a mixture of gas and air and exploded the contents by means of a small sparking coil and plug, and the tongue of flame which shot out of the joint opposite a small cut in the rubber was positive proof of the danger of this type of box. The other box was of considerable stouter build, and the joint between the body and the lid was simply a flat machined face about 2 in. wide. Exploding a charge of gas in this box produced no effect beyond a dull thud. The chief point is the cooling action of the large mass of metal surrounding the joint, which cooled the burnt gas to a temperature far below that at which it could ignite any gas which might be in the air immediately surrounding the box.—Lond. *Elec. Rev.*, March 18.

Electrophysics and Magnetism.

Ionization Produced by Entladungsstrahlen and Experiments Bearing on the Nature of the Radiation.—Elizabeth R. Laird.—The author has formerly shown that a solid salt solution, $CaSO_4$ + 2 per cent $MnSO_4$, is made thermoluminescent by the action of a radiation from the spark of a Wimshurst machine or induction coil, that the effect increases with increased capacity or potential difference, that the radiation is propagated in straight lines, as evidenced by shadows, that it is stopped by quartz and other solid substances, that it is not affected by a strong air blast, that it is somewhat more absorbed by carbon dioxide than by air. These experiments have now been carried further, and experiments have also been made showing that the same agent produces marked ionization in the air, and in other gases and vapors. The author describes experiments on the thermoluminescent effect and on the ionization effect, also experiments showing that the thermoluminescence and ionization are due to the same cause, and experiments showing that the ionization takes place in the air or gas in the chamber, and is not an effect of the metal electrode or walls of the chamber, nor of the diffusion into the chamber of ions from the outside, and experiments indicating that the ionization observed ordinarily in the neighborhood of a spark is almost entirely due to this radiation. Finally, some experiments on reflection are described.—*Phys. Rev.*, March.

Electrochemistry and Batteries.

Dry Cell.—A description of a new dry cell of J. T. Szek shown in Fig. 2. The carbon electrode is corrugated and a depolarizing mass of manganese peroxide, graphite and other substances is pressed around it. As shown, two vertical air passages *A* are left between the carbon and the depolarizer *B*, and these are connected together by hole in the carbon at *J* and at the bottom by a horizontal passage *H*. The object of these is to enable the air to reach the depolarizer and revive its activity. The electrolyte consists of a paste of sal ammoniac and flaked rice. This is spread over a loose woven fabric *C* which is then wound round the depolarizer, and on both sides by a sheet of expanded zinc *D*, which is bent in the form of a cylinder. The whole is covered with treated paper *E* and inserted in a papier-mâché case *F*. Discharge curves with continuous and intermittent discharges are given.—Lond. *Elec. Eng'ing*, March 17.

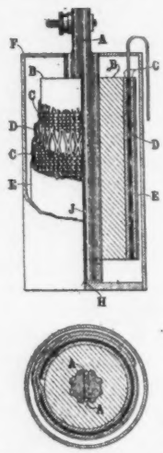


Fig. 2—Section and Plan of Dry Cell

Electric Furnaces.—J. Harden.—After a few brief notes on the arc furnaces of the Stassano and Héroult type, the author deals at greater length with the induction furnace and its modification by Roechling and Rodenhauser, giving data of cost of operation and also discussing the power factor. The author emphasizes that the electric furnace will not replace the open-hearth, but is being used in connection with it. It is far more economical, at least in cases where large quantities of medium-quality steel are required, first to melt the material in a gas-fired furnace, remove the carbon, which requires only a comparatively low temperature, and also the phosphorus for the same reason; then to pour the partially refined steel into the electric furnace, where the phosphorus, sulphur, occluded gases and other injurious compounds can be removed. The removal of these latter impurities requires a considerably higher temperature than the foregoing stages, and it is obvious that if the temperature must be raised by means of a gas flame applied on the surface of the bath the heat losses must be very great. The elimination of the occluded gases is the last and perhaps the most important stage of refining, if a really high quality of steel is to be obtained, and this can be best carried out in an electric furnace. In the case of crucible steel, however, the exclusive melting by means of the electric furnace seems fully justified and economical.—Lond. *Electrician*, March 18.

Electric Steel Furnace.—An illustrated description of the South Chicago electric furnace plant of the U. S. Steel Corporation, where the Héroult furnace is used to refine molten Bessemer metal. Data are given from the works records as to the time of successive heats, energy consumption, and composition of steel produced, also cost of repairs, etc. A record of one complete heat is also given.—*Met. and Chem. Eng'ing*, April.

Electric Furnace Electrodes.—C. Hering.—An article in which the author discusses the difference between the condition under which the electrode loss is a minimum, and the condition under which the hot electrode end is at the same temperature as the furnace charge. If the thermal and electric conductivities of the electrode material are independent of the temperature,

both conditions are identical, but this is no longer the case if the conductivities change with the temperature. The author discusses how to deal with the more general case and reaches the conclusion that the corrections which must be made on account of changing conductivities are in general too small to be considered in practice.—*Met. and Chem. Eng'ing,* April.

Fusion of Carbon.—M. LA ROSA.—The author's examination of the spectrum of the musical arc led him to the conclusion that the temperature of this arc is higher than that of the continuous arc or of the electric furnace, and the attempt was, therefore, made to effect the fusion of carbon by means of the musical arc. In these experiments the author thinks he has been successful and he concludes that by sufficiently rapid cooling he should be able to obtain the carbon in the form of diamond. He really produced a few very small particles transparent, crystalline and of high refractive power. But the fact that the particles are really diamonds has not yet been conclusively proven.—*Transactions,* Faraday Society, Vol. 5, No. 3, February.

Aluminium.—B. NEUMANN AND H. OLSEN.—An account of experiments on the production of aluminium in the laboratory. In the arrangement of the apparatus the authors endeavor to imitate commercial practice. They describe under what conditions the so-called anode effect takes place. The best amp-hour efficiency which they obtained was 70.4 per cent.—*Met. and Chem. Eng'ing,* April.

Electrolysis of Sodium Chloride.—R. TAUSSIG.—An article giving an account of experiments on the use of the mercury cathode cell for sodium chloride electrolysis with brief descriptions of the different mercury cathode cells in commercial operation.—*Transactions,* Faraday Society, Vol. 5, No. 3, February.

Ozone.—An illustrated description of various ozonizers made by a British company and used in connection with ventilators for purifying the air in rooms.—Lond. *Elec. Rev.,* March 18.

Electrochemistry in 1909.—F. M. PERKIN.—A review of progress during the last year in electrochemistry and electrometallurgy, dealing especially with the fixation of atmospheric nitrogen, electric steel refining, aluminium manufacture, etc.—Lond. *Electrician,* March 18.

Units, Measurements and Instruments.

Platinum-Iridium for Hot-Wire Instruments.—R. HARTMANN-KEMPF.—The main trouble with hot-wire instruments is their unsteady zero point. The author has made an extended investigation of the physical conditions in existing hot-wire instruments and has found that with the usual platinum-silver wire the maximum temperature is not above 100 deg. C. Under these circumstances variations of only a few per cent of the temperature of the room require compensation and if the method of automatic compensation is slow it is necessary to control the zero point repeatedly. It would be different with a maximum temperature of 300 deg. C. or 400 deg. C., but this is impracticable with platinum-silver. On the other hand, such a temperature can be easily used with platinum-iridium so that the latter is more suitable for hot-wire instruments in spite of its lower coefficient of elongation, which is only one-half that of platinum-silver. But platinum-iridium stands more than double the heat and can be drawn into much thinner wire. For a voltmeter wire a thickness of 0.03 mm is sufficient. With a current of 0.15 amp it reaches a temperature of more than 300 deg. C., and in spite of its smaller coefficient of elongation, the actual elongation is almost twice that of the usual platinum-silver wire. The Hartmann & Braun Company have redesigned their hot-wire instruments for platinum-iridium wire, the new design being shown in Fig. 3. In those new instruments the difficulty of the unsteady zero point has been satisfactorily overcome. The hot wire *h* is stretched between *a* and *b;* at about its center it is connected by means of a bridge wire with the point *c*. The silk fiber *g* leads to the roll *r*, while the smaller roll r_2 is connected, also by a silk fiber, with the spring *f*. The compensation plate consists of a thick large iron sheet *e* and a small piece of nickel steel. The latter has a very small coefficient of elongation (about 0.0000008) so that the iron piece *e* (elongation coefficient 0.000012) compensates for the elongation of the longer platinum-iridium wire. The oscillations of the needle *g* are dampened by the eddy currents of the aluminum disk *s*, which moves freely in the gap of the steel magnet *m*.

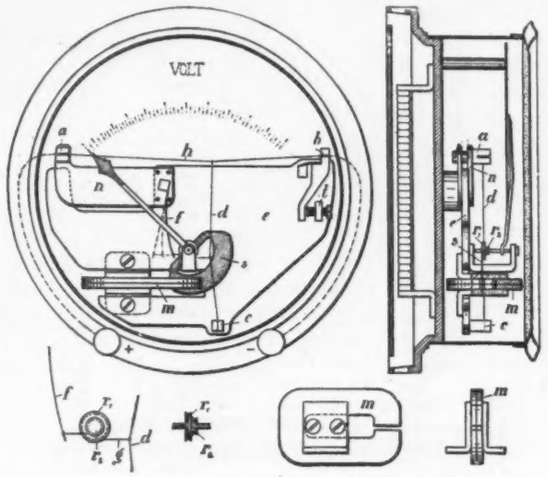


Fig. 3—Diagrams of Hot-Wire Instrument.

The whole movable system, comprising axle, needle, rolls and dampening disk, does not weigh more than 0.6 grams.—*Elek. Zeit.,* March 17.

Cast-Iron Permanent Magnets.—A note on a recent British patent of F. Burks (5360, 1909; March 10, 1910). The patent refers to the method of making cast-iron permanent magnets, the mechanical advantages of which were noticed in the Digest last week. The heat treatment and mechanical treatment are as follows: The magnet is cast in porous gray iron and is heated to a temperature of 2000 deg. Fahr., and then immersed in a bath consisting of salt, cyanide of potassium, nitric acid and prussiate of potash dissolved in water. The cyanide hardens the iron, which is then ready for magnetizing.—Lond. *Elec. Eng'ing,* March 17.

Thermometric Scale.—A. L. DAY AND R. B. SOSMAN.—An abstract of an American Physical Society paper on the nitrogen thermometer. The investigation of the fundamental high temperature scale with the nitrogen thermometer, which was begun in the Geophysical Laboratory in 1904, is now completed up to the temperature of melting palladium. The melting points, determined with highly improved apparatus, of the pure substances commonly used as standards in high temperature measurements are contained in the following table, together with the e.m.fs. in microvolts of the standard (Pt 90, Rh 10) thermoelement.

	t		*E*
Cadmium	320.0°	± 0.3°	2,504
Zinc	418.2	± 0.3	3,429
(Interpolation point)	524.9	...	4,470
Antimony	629.2	± 0.5	5,530
(Interpolation point)	854.1	...	7,929
Silver	960.0	± 0.7	9,113
Gold	1,062.4	± 0.8	10,295
Copper	1,082.6	± 0.8	10,534
(Interpolation point)	1,206.4	...	12,000
(Interpolation point)	1,298.5	...	13,100
Diopside	1,391.2	± 1.5	14,228
Nickel	1,452.3	± 2.0	14,977
Cobalt	1,489.2	2.0	15,439
Palladium	1,549.2	± 2.0	16,143

A quadratic equation of the form $E = -a + bt + ct^2$ passed through the melting points of zinc, antimony and copper, reproduces all temperatures within this region with an accuracy equal to that of the absolute measurement. A similar curve passed through copper diopside and palladium reproduces the upper region equally well.—*Phys. Rev.,* March.

Weston Cell.—F. E. SMITH.—A paper read before the (Brit.) Physical Society on cadmium amalgams and the Weston standard cell. The author describes a series of researches on the Weston standard cell, with chilled and slowly cooled amalgams containing from 1 per cent to 25 per cent of cadmium. The limits of temperature between which amalgams of various concentrations can be usefully employed are ascertained, and the

author suggests that the 12.5 per cent amalgam in the Weston standard cell be replaced by a 10 per cent amalgam.—Lond. *Electrician,* March 18.

Telegraphy, Telephony and Signals.

Loaded Submarine Telephone Cable.—An illustrated description of the construction of the new submarine telephone cable between London and Paris on which the Pupin system of loading with inductance coils is employed. Instead of its scope being limited to conversations between London and Paris, it has been designed so that it will be possible to converse through it between Paris and all the large towns in the Midlands and North of England, and even to Glasgow, by utilizing the existing land lines. The cable is a four-core cable with conductors weighing 160 lb. to the mile, insulated with 300 lb. per mile of gutta percha, the resistance of the conductors per loop-mile is 12.5 ohms, and the wire-to-wire capacity 0.12 microfarad per mile. The inductance coils, each of slightly less than 6 ohms resistance, with an inductance of 0.1 henry at 750 cycles per second, are placed at one nautical mile (1.153 miles) apart.

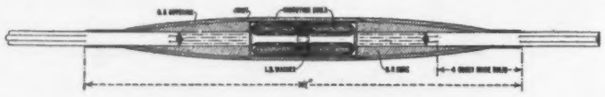


Fig. 4—Arrangement of Coils in Cable.

The arrangement of the coils in the cable is shown in Fig. 4. The actual attenuation constant of the cable is 0.0140 per mile, while the cable without its inductance coils has an attenuation constant of 0.045 per mile. Instead of four coils, one inserted after the other, one for each of the four wires of the cable, two double coils are employed. Each double coil consists of two windings on the same iron core, and one winding is connected in series with each conductor. This has an advantage over four distinct coils, as the iron core experiences an ageing effect which affects its permeability, and may not be precisely the same in two cores. If separate coils on separate iron cores were used for the go and return circuit, the gradual change in premeability might disturb the even balance of the circuit, but by winding them on the same core the variations are automatically compensated. Between the silk-covered wire of the coils and the gutta-percha sheet there is a sheet of metal foil; this was found to be a necessary precaution in the construction of the cable. An annular rubber distance-piece is inserted between the two sets of coils to give greater flexibility.—Lond. *Elec. Eng'ing,* March 17.

Wave Detector.—E. M. Wellisch.—A paper read before the Cambridge Philosophical Society on an electric detector for electromagnetic waves. The arrangement is shown in Fig. 5.

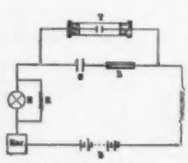


Fig. 5—Wave Detector.

The detector consists of a glass tube *T* (about 4 cm in diameter) and two parallel aluminium disk electrodes (each 2 cm in diameter) distant 1 cm from each other. The tube is connected to a mercury pump and a gage so that the pressure of the gas (dry air) can be adjusted and measured. In the diagram *B* represents the battery, one of whose poles is earthed, *E* the electrometer, *R* a high-resistance resistor (consisting of conducting glass) shunted across the electrometer, *C* a condenser of variable capacity, and *L* a reactor of variable self-inductance. The object of the high resistance resistor *R* is to cause the needle to return quickly to its zero so that any succeeding impulse may be readily detected. If the arrangement is such that the gas is on the verge of breaking down, electric waves fall upon the vacuum tube, producing a discharge of the gas, which may not be luminous, but manifests itself by the deflection of the electrometer *E*. —Lond. *Electrician,* March 18.

Telegraphy and Telephony.—Devaux-Charbonnel.—The conclusion of his illustrated summary of recent progress in telegraphy and telephony. The author describes the Mercadier system of multiple telegraphy, and especially his monotelephone. He then deals with the German cable between Emden and Teneriffa (in which the cable core in deap sea is of a different type from the core along the coast); a new German method of locating cable faults, and a method used in Copenhagen for the automatic selection of service lines between different telephone exchanges.—*La Lumière Elec.,* March 5.

Telephony.—H. C. Stiedle.—The first part of an article on the best tariff and other engineering problems of telephony if the telephone system is owned by the state. In the first part the author gives diagrams showing the total cost under different conditions of connections.—*Elek. Zeit.,* March 17.

Telegraph Circuits.—H. H. Harrison.—An article illustrated by diagrams on central-battery omnibus telegraph circuits.—Lond. *Elec. Eng'ing,* March 17.

Miscellaneous.

Earth Plates for Lightning Conductors.—A note on a new kind of earth plate used by the London County Council for lightning conductors. It has an earth plate in which tongues are cut and bent outwards to form a number of points from which the discharge may more readily take place. Fig. 6 shows

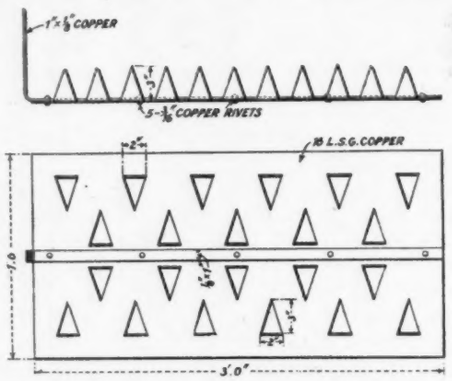


Fig. 6—Diagrams of Earth Plates.

the arrangement in detail for earth plates 3 ft. x 1 ft. 6 in. It was the custom until recently to use two such earth plates with a branching tape. This has recently been modified, and one plate, 3 ft. square, only is now used, the specification for which is as follows: "The earth plate to be of copper No. 16 gage; the conductor to be riveted and soldered the full length of the plate; the joints to be thoroughly washed free of acid and protected by a thick coat of tar; each plate to have four rows of triangular tongues formed out of the plate itself—two outer rows of six and two inner rows of five—so that the tips of tongues in adjacent rows point in opposite directions, each tongue being 3 in. long and tapering from 2 in. to a point; the tongues to be bent at right angles and to point upward when the earth plates are laid in position." The loose earth or wood charcoal is filled in and well rammed on to the top of this plate.—Lond. *Electrician,* March 18.

Electric Welding.—A. Scott Younger.—A paper read before the Institution of Engineers and Ship Builders in Scotland on steamship repairs by electric and oxy-acetylene welding. The author first describes the electric arc welding process of Mr. Kjellberg, of Gothenberg, and shows its application to the repair of boilers, machinery and ships. The operator holds a steel rod in his hand, which forms one electrode. By passing this rod along the surface to be welded an arc is formed and the weld is produced. He also gives particulars of the oxy-acetylene process of welding and compares it with electric welding.—Lond. *Electrician,* March 18.

The Effect of Ultraviolet Rays on Fermentation.—Maurain and Warcollier.—A paper presented before the French Academy of Science. The authors had formerly studied the effect of the rays from a quartz mercury-vapor lamp on cider in the process of fermentation, and they have now extended the same research to sparkling white wine. They find that the sterilization of white wine is easier than that of cider, because the white wine is more transparent for the effective rays.— *La Lumière Elec.,* March 5.

German Electrical Industries.—R. Bürner.—An English translation of his recent German paper on the state of the electrical inductries in Germany in 1909.—Lond. *Electrician*, March 18.

Mica Tubes.—K. Fischer.—The author gives the results of tests of a new kind of mica tubes which contain no paper and very little binding material, and which have a very high perforation voltage and combine great mechanical strength with smooth surfaces even at high temperatures (up to and above 200 deg. C.)—*Elek. Zeit.*, March 10.

Electric Accidents.—S. Jellineck.—An abstract of a lecture held before the Association of Austrian and Hungarian Electricity Works. The author emphasized that there are many wrong ideas prevailing concerning the best methods of resuscitation in case of electric accidents. It is wrong to place the head of the injured man at a lower level. While it is important to revive the heart, it is also important to bring the injured man to breathing again, since in this way new oxygen is supplied to the body. Trials of revival are often too short, since in many cases success has been obtained only after two hours of work. The speaker recommended a formulation of exact rules.—*Elec. Zeit.*, March 10.

Prize Competition in Earthing.—In view of the accidents which happened last year in Olginate, where high-voltage current entered into the distribution network and caused fires and injuries to persons, the Italian Government Department of Agriculture, Industry and Commerce has offered a prize of 10,000 lire (about $2,000) for the best theoretical and experimental investigation of the problem of earthing in industrial electrical installations. The competition is international, and the papers must be sent to the department by Dec. 31, 1910.—*Elek. Zeit.*, March 10.

New Apparatus and Appliances

TRAIN DESPATCHING BY TELEPHONE.

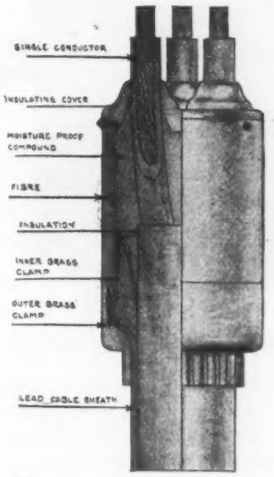
The Southern Railway is putting into service one of the most modern equipments in this country for dispatching its trains by telephone. The division being equipped extends from Greensboro, N. C., to a little beyond Lynchburg, Va., comprising about 124 miles of road with 36 way stations. The equipment is of the latest type furnished by the Western Electric Company and employing Gill selectors. Not only are the trains handled by the telephone over this busy division, but the regular message work on the line, which has heretofore always been taken care of by telegraph, is now being accomplished by means of the telephone.

Besides the train wire and the message wire, two heavy copper circuits over which conversation can be carried on even better than on the commercial long-distance telephone line, the Southern road is also equipping its block wires with telephones, so that train movements from one block to the next are controlled by the tower man by word of mouth, instead of telegraphic signals.

The equipment installed is most interesting. In front of the dispatcher is a cabinet containing 36 keys, one for each way station on the line. When he wishes to call a way station he gives that particular key a twist and as a result a mechanism is started which rings the bell of that particular station and of no other on the line. This is accomplished by means of the Gill selector, by which it is possible to pick out from a number of signals coming over a line the one which calls that particular station alone.

POTHEAD FOR CENTRAL-STATION WORK.

The accompanying illustration shows a station pothead brought out by the Fairmount Electric & Manufacturing Company, of Philadelphia, which is adapted for hard service. The device has a metal base and insulating body and cover plate. The metal base effectually forces the lead sheath away from the conductors and insulating covering. This prevents the lead from being forced into the insulation, and is a safeguard against careless or inefficient workmanship. A clamping feature provides a simple and inexpensive means for making a water-tight joint between the lead sheath and the pothead. It is claimed that this method of construction is equal to the wiped joint, and has the additional advantage of not requiring the services of a plumber or cable splicer. An inside bell is said to prevent a static discharge between the cable and the sheath. The construction provides a smooth and circular inside face, gradually diverging from the conductors and producing a uniform gradation of the static stresses induced in the cable. The insulating cover plate and fiber body separate the single conductors and protect them from mechanical injury. The bushings of the cover plate are constructed so as to allow the insulating compound, which is poured in the body of the pothead, to ooze up around the single conductors and thus materially to increase the surface breakdown distance between



Pothead for Central Station Work.

them. The metal base acts as a support to the cable end, and affords a means of grounding the lead sheath. One of the most important features of the pothead is the construction of the inner clamping member, which is a continuation of the lead sheath, gradually diverging from the conductors. This is said to be a sure and certain way of carrying off and increasing the distance of any discharge of static stresses.

OUTLOOK FOR THE COMMERCIAL ELECTRIC VEHICLE.

Mr. Philip D. Wagoner, the recently elected president of the General Vehicle Company, of Long Island City, made his first visit to St. Louis and Chicago in his present official capacity a few days ago. In the latter city he was asked his opinion of the status of the electric commercial vehicle industry and he answered that he thought that the central stations were waking up to the situation. Mr. Wagoner is of the opinion that the time is coming when the electric service companies will consider the commercial-vehicle load as an extremely important factor in their business. Chicago has been backward in introducing electric power wagons and is now where New York was several

years ago. Chicago seems to be "gasoline crazy" in the matter of commercial vehicles, but in New York it has been demonstrated pretty conclusively that, with the exception of long-haul traffic, the electric truck is superior to the gasoline machine. Mr. Wagoner mentioned the interesting fact that practically all of the United States mail north of Forty-second Street, in Greater New York, is carried on electric trucks manufactured by his company. A small part of the first-class mail is partially handled by means of pneumatic tubes, but this proportion is relatively unimportant. About 24 of these electric mail trucks are used by the Government in New York City for this service. In New York City the electric truck is proving popular in meat-handling industries and also in gas and coke establishments and for many other purposes. All told, there are probably about 1000 electric trucks and delivery wagons in service in New York City.

In relation to the design of the wagons, Mr. Wagoner explained that an effort is made to standardize the vehicles turned out as much as possible to avoid the use of special types. The largest trucks made by the General Vehicle Company are rated to carry 5 tons each.

TRANSFORMER FOR LOW-VOLTAGE LAMPS.

In order that tungsten lamps of low voltage may be used in factories and apartment houses, where high-voltage lamps without some means of absorbing shocks would show too large

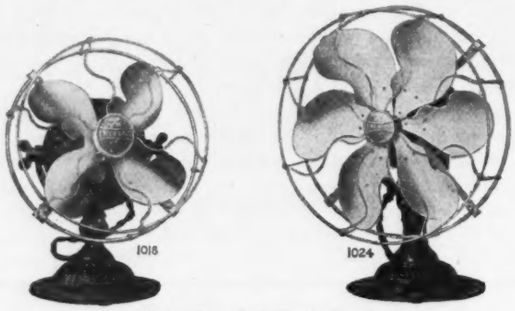
Transformer for Low-Voltage Lamps.

a percentage of breakage, the Enterprise Electric Company, of Warren, Ohio, has brought out the transformer illustrated herewith. This has been designed for connection across present alternating-current circuits of 110 volts, and is wound to give 28 volts. This makes the device applicable for 28-volt to 32-volt lamps, which are listed in sizes of 10 watts, 15 watts, 20 watts, 25 watts and 40 watts by the lamp manufacturers. The transformers are built for either inside or outside installation, and are mounted in cast-iron cases filled with moisture-proof insulating compound. They are designed to give the rated voltage at full load, and to withstand a 50 per cent overload, so that a transformer could be installed for the ordinary number of lamps burned, there being sufficient overload capacity to care for all of the lamps whenever these are required to be lighted.

EMERSON FANS.

The line of fans offered by the Emerson Electric Manufacturing Company, St. Louis, Mo., and New York City, includes a number of new types. As heretofore, the company furnishes desk, bracket, oscillating, ceiling and column styles for alternating-current circuits, and desk and bracket styles for direct-current circuits. The 8-in. alternating-current fan brought out last season has been retained, with the addition of 12-in. and 16-in. sizes of the same general design. These have oil-type, dust-proof bearings of hardened steel and Parker blades. For residence use, a slow-speed, six-blade fan has been provided, which, it is claimed, throws a moderate breeze without objectionable noise.

The new types of oscillating fans brought out by the company have the same hardened-steel bearings and Parker blades as the swivel-trunnion fans. These are positive-acting, geared-type oscillators with an adjustable range of oscillation and ad-



Figs. 1 and 2—Desk Fans.

justable blades, permitting the base to be tipped up or deflected. They may also be converted into bracket fans without extra parts; the adjustable base gives the desired trunnion effect. A feature of the 1910 model oscillators is the fact that all wearing parts of the oscillating mechanism, including the worm shaft, may be renewed by the user with a screwdriver in a few minutes. A residence-type, slow-speed oscillating fan of this design is one of the novelties offered this season.

The Trojan desk fans made by the Emerson company are furnished in 12-in. and 16-in swivel-trunnion sizes, and 12-in. and 16-in. oscillating fans with conventional triangular blades and bronze bearings.

A new method of installing alternating-current ceiling fans is illustrated in Fig. 3, and is recommended by the company, particularly where ceiling fans are installed in connection with metal-filament lamps. In this method, the fans are hung with the blades 9 ft. or 10 ft. from the floor, well up above the lamps, so that they throw no shadows. An extension switch handle is furnished for procuring the three speeds of the fan. These ceiling fans are so arranged that lamps may be attached to them without special electrolier parts. It is claimed that the metal-filament lamps may be satisfactorily hung from the ceiling fans if the fans are suspended from a solid ceiling.

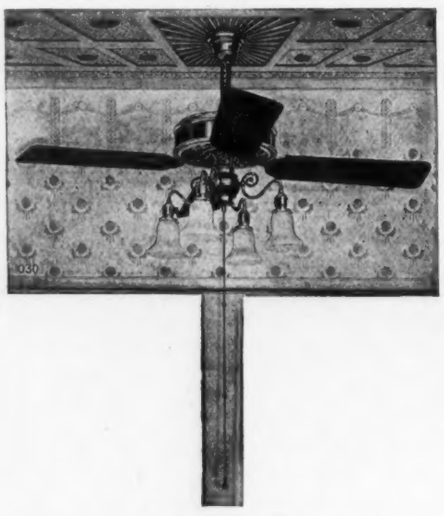


Fig. 3—Ceiling Fan.

The Emerson ornamental type, four-blade, three-speed ceiling fans and the Trojan or plain type four-blade, two-speed fans are still made, and a new type of two-blade residence ornamental ceiling fan, with a sweep of 60 in., has been brought out this season. Column and counter-column fans are furnished in any of the styles corresponding to the ceiling fans.

THE BAKER STATIC MACHINE.

That the electrostatic generator can be given an entirely practical and commercial form, as compared with the usual laboratory type, is shown by the machine illustrated herewith, made by the Baker Electric Company, Hartford, Conn. Though comprising measuring adjuncts and other accessories of a scientific character, the apparatus as a whole has the characteristics of simplicity, durability and efficiency which are typical of modern electrical apparatus used in other lines of electrical work. The desirability of a large electrical output in proportion to weight and space occupied, together with the development of a most satisfactory high-speed rotating plate, led to the adoption of the Toepler-Holtz type, and the manufacturers state that the calculations, experiments and tests have proved the wisdom of this decision. The Baker static machine may be considered as consisting, broadly, of one or more groups of the following elements:

A disk of insulating material so supported that it can be revolved by the side of and in proximity to an electrically charged conducting segment or segments, together with collecting and distributing devices. The rotating disk may be considered as normally without electrical charge, but as it approaches a charged and insulated segment it is locally charged by induction. A charge of opposite polarity appears on the side nearest the segment, while a charge of similar polarity to that of the segment is induced on the outer side of the disk. Upon revolving the disk this charged portion passes between the segment and a collecting device electrically connected therewith, when a portion of the charge on the outside of the disk is removed by the collecting device and added to that already in the segment, increasing its potential or making up for leakage losses.

After leaving this collecting device the portion of the disk under consideration still moving near the segment has more charge induced in it, which is collected by a second device connected with the discharge terminals of the machine. After further movement the disk passes near a third collector so arranged and connected as to neutralize any remaining charge and then the cycle of operation is repeated, but with an oppositely charged segment.

As the disk is an insulator, the charges are local, but the

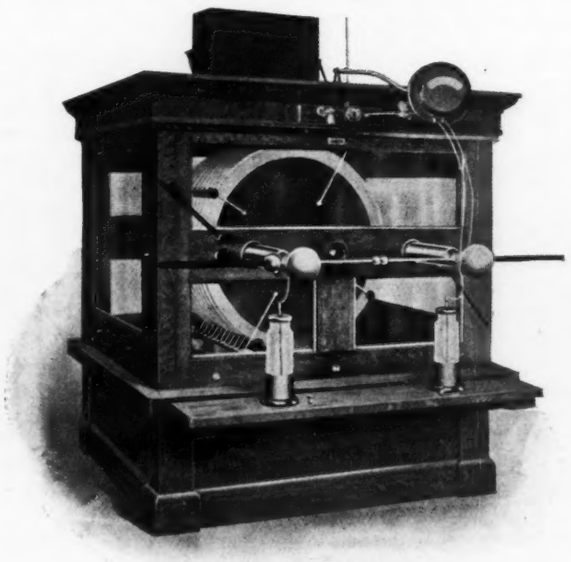


Fig. 1—Static Machine.

cycle of changes is a continuous one and the electricity delivered to the discharge terminals appears in the form of a continuous current whose value and potential depend on the amount of disk surface passing under the collectors in unit time and the potential of the inducing segments. This is strictly true only when the external circuit is a continuous one, as the relatively large electrostatic capacity present will cause oscillations or pulsations if a disruptive gap be included in the circuit. The electrical current delivered will, therefore, depend on, and vary with, the surface velocity, number of disks, and the nature of the material used, although a portion of it will be lost in leakage at the higher potentials. For any given external circuit resistance the potential will vary in the same way.

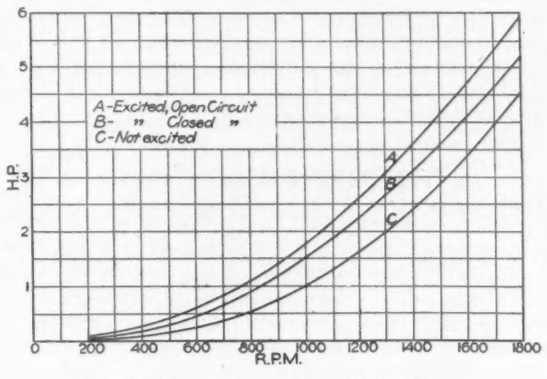


Fig. 2—Curves of Test of Static Machine.

That is, the maximum output in power (current × potential) will vary with the square of the speed.

While there is no complete internal electrical circuit in the ordinary sense, a static machine can be considered as an electric generator with a very high internal resistance. It is reversable in its action under proper conditions, although as a motor it is not at all efficient. Its apparent internal resistance, while very high, is not constant, but varies with change in output and speed. This is easily demonstrated experimentally by comparing the current output when the machine is short-circuited, and when a large non-inductive resistance is connected in circuit under the various conditions. Were it not for leakage and short-circuiting, the e.m.f. of a machine of this kind on open-circuit would be unlimited and the rate of increase in voltage would depend only on the charge generated in unit time. The leakage, however, increases rapidly with increase in potential.

As the leakage increases with the potential only, and the maximum potential varies with the rate of current output, a point will be reached with any machine when the leakage will cause the current to be dissipated as rapidly as generated, and when this point is reached no further increase in potential can be expected. A consideration of this will show that, other things being equal, the greater the output of a machine, the higher the ultimate potential. The maximum e.m.f. is further limited by disruption of and discharge through the dielectrics, air and other insulators in the machine.

As the potential difference in these machines may be, and frequently is, many hundred thousand volts, the materials used must not only have very high insulation resistance, but also great dielectric strength. Many materials that are perfectly satisfactory for ordinary potentials are useless when subjected to the high electrical stresses here present. Hard rubber and glass have been found to be best suited to these conditions and they are used wherever possible. Moisture and dust are conductors under the conditions existing in these machines, and especial care is taken to so treat the surfaces that no conducting films can form. Moist air is also to a certain extent conducting and should be avoided as much as possible when one of these machines is used.

The "De Luxe" type, shown in the accompanying cut, is the latest development, and is just being put on the market. In addition to excellence in material and workmanship, this "Baker" machine has an especially large and heavy case with increased internal air space and Hess-Bright ball bearings. The output is never less than 1 milli-amp per pair of rotating plates at full speed and at short-circuit or with any of the ordinary circuit resistances. By means of the regulator levers this current out-

put may be reduced to any desired extent without changing the machine potential.

The curves of Fig. 2 are taken from a power test of a 6-milli-amp machine running at 1800 r.p.m. While efficiency in a machine of this kind is not ordinarily of much importance, that shown is very high. In the unexcited condition (Curve C) the bearing loss is inappreciable, and practically all the energy dissipation is due to friction between the air and the rotating plates. Comparison between input and output under loaded conditions proves that a large portion of this friction loss disappears when the plates are in the charged state and that the actual commercial efficiency is much greater than would be determined by the power test.

HOT-WIRE OSCILLOGRAPH.

The hot-wire principle has long been used in the construction of instruments intended to measure the root mean square value of current, but on account of the time lag of the temperature was not considered as suited to oscillograph work, where the response must be instantaneous and accurate.

The relation between extension and temperature is utilized to get the indications and where temperature equilibrium exists there is a fixed relation between the current in the wire and the elongation; however, if there is a sudden change in the value of the current, the specific heat of the metal will cause heat to be absorbed or released and thus retard the change in temperature and therewith the indication of the current. This retardation effect is similar to inductance and is greatest where the current changes most rapidly, that is, where the current wave passes through zero.

Mr. J. T. Irwin has invented a hot-wire oscillograph, in which the time lag of temperature is compensated by connecting a condenser in series with the hot-wire. The condenser current, which is maximum at the instant the e.m.f. passes through zero, supplies heat in an amount proportional to the rate of change in the value of the current to be measured.

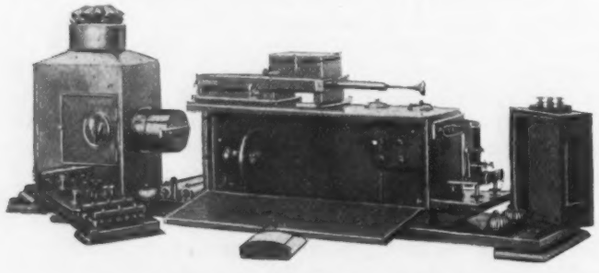


Fig. 5—Hot-Wire Oscillograph.

The condenser is shunted by a resistor, thus allowing the current to be measured to pass through the hot wire superposed upon the compensating current through the condenser.

Circuit diagrams of the Irwin hot-wire oscillograph are shown in Figs. 1 to 3. The hot-wire *CD, EF,* is divided into two parts so as to compensate for changes in the air temperature. A source of e.m.f *B* is connected as shown and sends a constant current through the wire. Upon this current is superposed that to be measured, in one section it is in the same direction and in the other in the opposite direction to that furnished by the battery *B*. If the battery current is *i* and the current to be measured *I*, the heating effect in one wire is $(I+i)^2R$ and in the other $(I-i)^2R$. The difference in the two produces the deflection.

The diagram shown in Fig. 1 is that of an instrument arranged to measure e.m.f. The resistor R_5 is used to adjust the damping coefficient of the electric circuit, there being little damping in the mechanical system. When used to measure currents the instrument is shunted by an inductive resistor, or else it is connected across the secondary of a special transformer, see Fig. 2. Fig. 3 shows a two-element oscillograph arranged to measure current and e.m.f. It will be noted that the battery and the measured current have been interchanged in one element. This gives a greater sensitiveness as the wires are connected in multiple across the impressed e.m.f., instead of both in series.

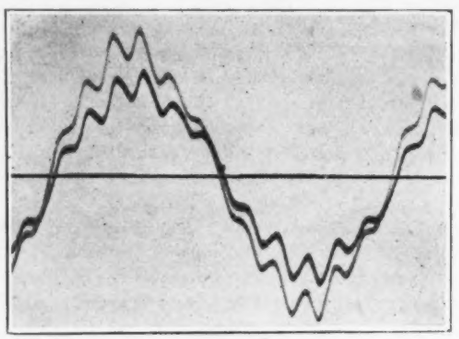
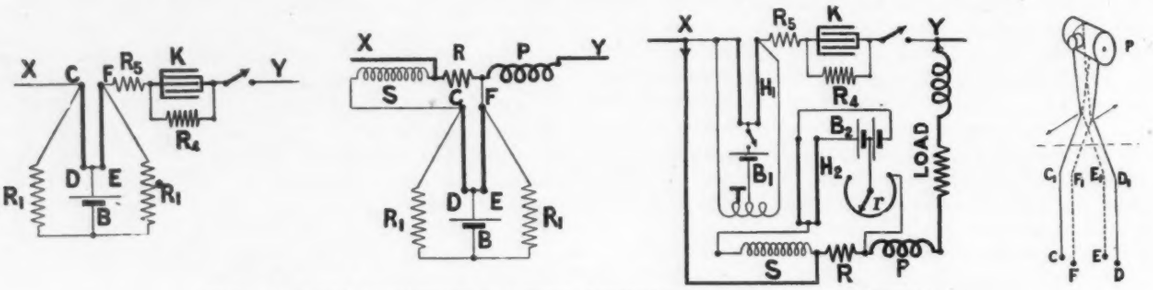


Fig. 6—Potential and Current Waves from an Alternator on a Nearly Non-Inductive Load, Showing Ripples Due to Teeth



Figs. 1, 2, 3 and 4—Diagrams of Various Applications of Hot Wire Oscillograph.

The method of suspension is shown in Fig. 4. The two hot-wires C_1, D_1, and E_1, F_1, are fixed at their lower ends, electrically connected at *ED*, and pass over an ivory roll *P*, crossing diagonally at the top, but insulated from each other. Two horizontal wires not shown in the diagram conect C_1 to D_1, and F_1 to E_1; they cross each other without touching and permit a vertical movement but no horizontal movement. These cross wires also serve as a short-circuit to the upper part of the loop and practically limit the current to the part below them. The wire between F_1 and the pulley is tied by an insulating loop of thread to the wire between D_1 and the pulley, the two other wires are similarily tied. A spiral spring attached to the roll, *P*, maintains an even tension on the wires. A mirror is fixed across the wires near the points where they are fastened together, and when the wire EE_1, FF_1 is heated more than the other the mirror is caused to rotate in the direction shown by the arrows.

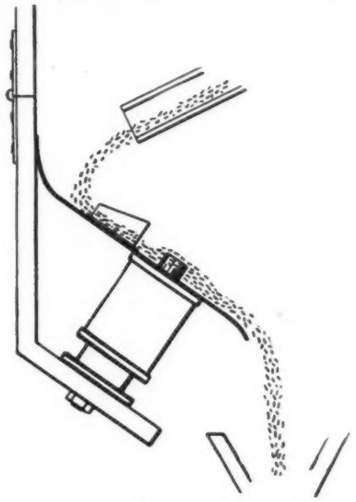
The sensitiveness of the instrument and the completeness of the compensation of temperature lag are shown in Fig. 6, which is an oscillogram of the e.m.f. and current of a generator on non-inductive load. The ripples are caused by the teeth.

This instrument is built by Robert W. Paul, New Southgate, London, and sold in this country by M. J. M. Denton, of Pittsburgh, Pa.

EXTRACTING IRON PARTICLES FROM GRAIN BY ELECTROMAGNETS.

Iron particles and nails which are picked up by bulk grain from the cars and containers in which it is shipped and stored frequently give considerable trouble later in the steel rolls of flour mills and breweries by producing sparks which cause explosions in the dry dust accompanying the grinding process, as applied either to malted or unmalted grain. In devising a remedy for this difficulty a large malting concern at Colehour, Ind., has experimented with magnetic separation to free its malted grain of all iron particles. At first, permanent magnets were tried, but as these did not prove strong enough to hold all the magnetic material they collected, electromagnets were resorted to, an entirely successful adaptation being made of a commercial type of small hand-lifting magnet, which was originally designed principally for the use of hardware storekeepers and others who have to handle quantities of nails and small iron pieces.

These magnetic separators have been added as the last process in the cleaning machines, from which the malted grain is finally made ready for shipment to the breweries. Each separator consists of a row of 10 of the small electromagnets referred to, their 20 pole-pieces of alternate polarity extending in a line through an inclined metal shelf over which the grain flows, as shown in the accompanying sketch. This shelf is about 6 ft. wide, and the flow of the grain over it, from the chute above,



Extracting Iron Particles from Grain by Electromagnets.

is deflected against the pole pieces by vertical barriers placed midway between each pair, to insure close contact of the grain. Any iron particles in the stream are thus caught and held by the pole pieces. In this way from 800 to 1000 bushels of grain an hour are freed of all magnetic substances, as the material passes on its way out of the "cleaner."

After several thousand bushels have passed through the machine, and sufficient material adheres to the magnets to make cleaning necessary, the shelf is swung back over a refuse pit, the source of energy cut off from the electromagnets, and a brush passed over them to remove such particles as still adhere by residual magnetism. Ususually, about a handful of material is thus collected from a carload of grain, although this amount varies greatly with the shipment, distance, etc. The separated material is mostly composed of nails from the car interiors and grain doors, shipping-tag tacks and staples, and iron rust from various sources. Previous to the installation of these magnetic separators many complaints were received of dust explosions which had occurred in the interior of the brewery rolls where the grain is finely ground. But since these electromagnets have been installed, during several months not a single report of a dust explosion has been returned to the malting company. Two cleaners, each with a capacity of 1000 bushels per hour, have been equipped with electromagnetic separation. Each magnet winding takes ½ amp at 110 volts, the row of 10 in each machine consuming about 550 watts. New machines to be fitted up with this means of magnetic extraction will be arranged with a double row of magnets mounted on a pivot, so that when one set needs to have its adhered particles brushed off the other set can be swung into place without interrupting the stream of grain. Credit for working out this useful application of magnetic separation is due to the officers and engineers of the Columbia Malting Company, Chicago, in whose malt houses at Colehour, Ind., the machines described have been installed. The electromagnets used are the standard small hand-lifting magnets of the Cutler-Hammer Manufacturing Company, which have been used without other change than the removal of their handles.

DUPLICATE BATTERIES FOR ELECTRIC VEHICLES

The General Vehicle Company has issued a circular advising owners of electric commercial vehicles to maintain duplicate storage batteries, thereby increasing at very slight cost the efficiency and capacity of their vehicles and also obtaining very much more satisfactory results.

There are two conditions which render it highly profitable and advisable for the owner of an electric vehicle to purchase and maintain duplicate storage batteries, namely: first, when the actual or possible service of a vehicle exceeds the mileage or capacity of a single battery, and second, when the owner operates his own electric power plant. Referring to the first condition, the major part of the investment is in the vehicle—not the battery—and if, by making the original investment a trifle greater to cover an additional battery, the earning power of the vehicle can be doubled, the advantage and economy are manifest. Suppose, for example, the working conditions of a business call for 2000-lb. capacity wagons. The standard 1-ton wagon of the General Vehicle Company has a guaranteed mileage of 45 miles on a battery charge, carrying full-load half way. Hills along the route would reduce this a trifle, say, to 40 miles. A method of making that vehicle cover 80 miles per day, thus doubling its earning capacity, is by shifting batteries at midday —a process consuming only a few moments' time. Of course, where a great many delivery stops are made and where the distance between stops is relatively short, it is doubtful if more than 40 to 45 miles could be covered, but such a plan holds great possibilities to shippers who make long-distance hauls. As a matter of fact, such procedure often enables the electric truck to invade the field of long-distance work, which has generally been conceded to the gasoline vehicle.

Where the shipper produces his own electric power, as in a manufacturing plant or large department store, for example, operating his generators during the working day only, duplicate batteries enable him to do his own charging during the day, working each set every other day, and saving the difference between the central station company's rate and his own cost for electricity. Under conditions where this system is possible, the savings in charging costs will pay a high rate of interest on the investment in an extra battery, with the further advantage of giving the engineer or electrician of the plant ample time to keep each battery in the pink of condition.

Batteries are generally arranged in several crates for ease of handling. Where the charging is done at night automatically, or supervised after simple routine directions by a night watchman—the actual management and care of the batteries being under a day man—electric-vehicle owners are advised to have on hand an extra crate. This enables the regular battery man to take plenty of time to keep every cell in the best condition without working overtime, and without interfering with the vehicle's regular service. If a cell in any crate is low, that crate can be removed for attention. Similarly, the specific gravity of the acid in each cell can be standardized at leisure, and cleaning of the trays of cells done thoroughly at convenient times by taking each in rotation. The cost of an extra tray is very small and the advantages to be derived under many conditions are worthy of consideration.

Industrial and Commercial News

The Week in Trade

DURING the past week the condition of trade continued to improve. While there is some irregularity reported in various portions of the West, owing to weather conditions, the situation as a whole is much better than for corresponding weeks last year. The volume of trading in the country is larger, and gains are satisfactory both in retail and wholesale lines. Business activity depends largely upon public confidence, and in this respect Wall Street is generally regarded as a barometer. During the past week Wall Street has not been either active or over-confident, and it is generally regarded that trade has in some measure suffered from this lack of confidence in the speculative markets. It is perfectly evident, however, that the majority of the producers, especially the farmers, are prosperous. The earnings of the railroad companies, as indicated by the March reports, are better than they have been since the spring of 1907. This shows a healthy movement of traffic, which, of course, improves business. The crop reports as a general thing are extremely favorable. The weather in the West has been altogether good for planting and the winter wheat reports are that no damage has occurred during the season when this is most liable. Crops both in winter and spring wheat will be large, and in fact much heavier than last year. The principal feature of the past week that was discouraging was the wide-spread strike order among the bituminous coal miners. This had in a measure been anticipated, but it means, unless speedily settled, a large falling off in the retail business of the sections affected. In structural materials and in agricultural implements there has been an increased demand. This was anticipated at the present season. Collections continue to be somewhat slow, although better than they were a few months ago. Failures for the week which ended March 31, as reported by *Bradstreet's*, were 232 compared with 231 the previous week, 204 in the same week of 1909, 247 in 1908, 137 in 1907 and 151 in 1906.

The Copper Market

THE copper market continues to be rather dull. The domestic takings are said to be far above what they were at the same period last year, but exports for the past month have not been particularly heavy. This is due to the fact that the surplus stock abroad has gradually increased, and the takings of foreign melters are not up to the supply that is reaching Europe. At the end of March, 1910, the visible supply abroad was estimated to be 249,625,600 lb. This is an increase of more than 100,000,000 lb. within a year, although the month of March showed about 4,500,000 lb. decrease. The monthly circular of D. Houston & Company about covers the true condition of the copper market. It says: "The consumption of copper in this country has reached a high monthly rate, and this fact constitutes one of the brightest features in the situation. American requirements have broadened out remarkably in recent months, and manufacturing activity is of gratifying proportions. There is undoubted evidence that domestic consumption is doing its good share to develop wider channels of distribution for copper supplies. Taking the broad view of the copper situation, the great increase in output and the consequent growth in surplus supplies have been the unfavorable features against which the market has had to contend. No sensible forecast of future market movements can afford to ignore the part these factors play at present. A United States output of 4,000,000 lb. of copper per day is too much for the health of the market, and if persisted in cannot fail to prolong the period of market depression." Prices during the past week were slightly lower, and electrolytic copper was sold at ¼ cent per lb. concession. It is now freely predicted that the market will sag below 13 cents before any important buying movement is developed. Imports during March continued to be quite heavy, and this is another feature discouraging to the American producers. Within the past week there has been more evidence of selling pressure than at any time during March. Exports for April, including April 4, were 945 tons. Standard copper was quoted on the metal exchange April 3 as per the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.77½	13.00	.....
April	12.77½	13.00	12.87½
May	12.80	13.00	12.90

The London market April 4 closed as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	58	2	6	58	2	6
Standard copper, futures	59	5	0	59	5	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50			12.87½		
London, spot	£62	0	0	£57	15	0
London, futures	62	18	9	57	17	0
London, best selected	65	10	0	62	5	0

Industrial and Commercial Notes

Crocker-Wheeler Company Sales.—The Crocker-Wheeler Company has recently booked a large number of orders for direct current apparatus, among which are the following: Engine type generators: One 150 kw to Garden City Brewery, Illinois; one 150 kw to Swift & Company, Chicago; one 200 kw to Lake Copper Company, Michigan; two 150 kw to Allegheny County Workhouse; one 150 kw to Logan Coal Company, Pennsylvania; two 200 kw to Watt Mining Car Wheel Company, Ohio; one 200 kw to Pittsburgh-Belmont Coal Company, Ohio; one 250 kw to Pope Tin Plate Company, Steubenville, Ohio; one 250 kw to Ames Iron Works, Pennsylvania; one 150 kw to Valley Camp Coal Company, Pennsylvania; one 150 kw to P. Ballantine & Sons, New Jersey; one 125 kw to Gould Paper Company, New York, and one 500 kw to Youngstown Iron & Steel Roofing Company. In addition to this the following motor equipments have been sold: Two 20-hp, two 15-hp and two 10-hp motors to the National Candy Company of Michigan; two 75-hp and one 10-hp rolling mill motor, sold to the Indiana Steel Company, of Indiana, for operating screw straightener; six 15-hp and four 100-hp motors to the Spanish-American Company, of Cuba; one 100-hp motor to John A. Roebling Sons Company, of New Jersey; two 75-hp, two 50-hp and two 15-hp series, wound rolling mill motors to the Alliance Machine Company, of Ohio; one 20-hp, one 15-hp, two 10-hp and one 5-hp motor to the H. J. Ruesch Machine Company, of New Jersey; one 50-kw generator, two 10-hp motors and one 15-hp motor to the Breeze Carburetor Company, of New Jersey. The company has also sold one 250-kva engine type alternating current generator to the International Silver Company, of Connecticut; two 500-kw motor generator sets to the Carnegie Steel Company, of Pennsylvania. Another order from Heany Lamp Company, of Pennsylvania, calls for one 150-kva alternating current and one 11½-kw direct-current generator.

General Electric Sales.—The gross sales of the General Electric Company have increased considerably within the past two or three weeks, according to the reports made by the officials of that company. The march orders, it is said, were at a rate that would be close to $80,000,000 a year. This is the highest level which has been attained by the company in its history. In January, 1907, the gross sales for a brief period were at a higher rate, but this only lasted for a week or two. One feature of the present business of the General Electric Company is that the sales are largely in small apparatus, which is said to be more profitable than heavy machinery. There has been an especially large increase in the sales of household appliances and heating apparatus.

New Hydroelectric Development in Washington.—Interests that are identified with the Superior Portland Cement Company have prepared plans for the construction of a hydroelectric plant on the Baker River, near Bellingham, Wash. It is said that this plant will ultimately develop about 25,000 hp. It is understood that turbines generating alternating current will be installed and that transmission lines will be built for high voltage.

Summit County Power Company.—The Summit County Power Company of Dillon, Colo., which is controlled by Henry L. Doherty & Company, has just purchased from the Westinghouse Electric & Manufacturing Company a 500 kw turbine generator unit. This apparatus is to be installed in the steam auxiliary to the power plant.

Sales of Allis-Chalmers Turbines.—A little over four years ago the Allis-Chalmers Company obtained the right to manufacture in this country the latest improved type of Parsons machine. The end of the first year saw only one unit in operation, but, since then, there has been a steady and rapid growth in sales, which has reached a total capacity of over 300,000 hp. Of this aggregate 48.2 per cent were sold during 1909 and 20.6 per cent have been placed on orders since January 1st, 1910. A large proportion of the units have been for use by power, lighting and railway companies and approximately 40 per cent of the total sales were for this purpose, textile manufacturers being next with 14 per cent of the machines. Practically every type of industrial enterprise is represented in the buyers of these turbines, including gas plants, cement mills, mines, lumber mills, flour mills, paper factories, tanneries, celluloid works, etc. In geographical distribution the machines are to be found in nearly every State in the Union and also in Canada and Mexico. Within the past week the company has closed a very large contract for ore-reducing machinery. Through its London office it has sold to the Union Miniere du Haut Katanga, of Brussels, Belgium, a crushing, concentrating and smelting equipment for a copper producing plant of 900,000 tons yearly capacity, including power house and electrical equipment, to be built near Lake Tanganyika in the Congo Territory of Central Africa. This order, which covers one of the largest and best equipped mining plants in the world, was obtained in a wide competition, because of the unique ability of an American company to supply all the machinery under a single contract.

Canadian Pacific's Plans for Toronto.—It is said that the Canadian Pacific Railroad has recently been purchasing real estate by the block, in the city of Toronto, with the purpose of constructing an independent entrance and building independent terminals. It is said that the road intends to cut adrift from the other railways and to establish its terminal station at the corner of Yonge and Carlton streets, right in the heart of what is rapidly becoming the retail district of the city. It is understood that plans are now being prepared at Montreal by the company's engineers, but Vice-President and General Manager David McNicoll, when questioned about the matter, was non-communicative, stating that the company was not prepared to announce its plans and he did not know when they would be able to do so. The Canadian Pacific Railway has had a line on the north limit of the city running through Rosedale, and it is understood that entrance to Toronto will be made by constructing an underground electric system from that point to the terminal site, or an alternative route extending from their present tracks along the bank of the Don River, and running in a direct line westerly from that point to Yonge street. The purchases of land up to the middle of March have cost over $3,000,000, and it is stated that 97 per cent has been secured.

Foreign Trade Opportunities.—Following are consular reports on foreign trade opportunities, concerning which further information may be obtained from the Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C. An American consul in Mexico reports that the construction of an electric railway line is contemplated (File No. 4692). An American consul in Australasia reports that a company has been organized in that district to expend $729,975 on a hydroelectric lighting and railway plant (File No. 4697). An American consul in a Latin-American country states that a company is considering many improvements in its electric lighting plant, and would like to get in touch with manufacturers of electrical supplies (File No. 4723). Another consul in Latin-America reports that a concession has been given for the construction of an electric railway, the government conceding the contractors free importation of all materials and equipment required (File No. 4726).

Aluminum Transmission Lines.—The Aluminum Company of America reports that there have been quite a number of good orders recently of transmission wires. The Pennsylvania Water & Power Company, the successor to the McCall Ferry Power Company, has contracted for aluminum wire for its line into Baltimore. It is not entirely setttled as yet as to how the Pennsylvania company will reach Baltimore, but it is the purpose of the company to reach that market in some way. Speaking of this one of the officials of the company said: "We are going into Baltimore. Whether we go under our contract with the Consolidated Gas, Electric Light & Power Company or independently is a matter for the courts to decide. But of one thing you may rest assured, we are going to sell power in Baltimore. This is our logical market. It is twenty miles closer than Philadelphia and it is in Baltimore that we should sell."

To Make Motor Vehicles.—The Chicago Pneumatic Tool Company is going into the business of making motor vehicles. President W. O. Duntley announces that next year the plant of the company at Franklin, Pa., will be devoted entirely to the construction of commercial motor vehicles. It is said that the output will be 100 cars per month. The resumption of dividends at the rate of 4 per cent. on the capital stock marks the recovery of the company from the business depression of 1908. During the last few months of 1909 the earnings of the company were at the rate of about 8 per cent. on the $6,485,000 outstanding stock. The report for the year shows gross earnings of $558,927, and net earnings of $250,609. The latter is compared with net earnings in 1908 of $21,513. President W. O. Duntley predicts that business for 1910 will establish a record for earnings.

Franchise Application in Chicago.—The application of the Madison Light Company for a franchise to sell electricity in the district bounded by Randolph, Dearborn, Madison and Clinton Streets, Chicago, for a period of 20 years, has been referred to the incoming city council. It is said that W. R. Hearst is back of this application, and that he desires to furnish electricity from a plant in his new newspaper building at Madison Street and the river. The Commonwealth Edison Company has objected to the proposed ordinance on the ground that the interests of the public will not be served by the existence of a number of small companies engaged in selling electricity; one company, with effective city regulation, is preferable, it is contended.

New Distributing Station for Jamestown, N. Y.—The Jamestown Lighting & Power Company of Jamestown, N. Y., of which A. N. Broadhead is now the principal proprietor, has bought a lot at the southwest corner of Washington and West Second streets, and will erect thereon a central distributing station in which will be installed rotary converters to transform electrical energy generated at the power station of the Jamestown Street Railway Company at the boatlanding. This follows the recent acquisition of the light and power company by the owners of the street railway company. The lot has a frontage of 120 ft. and is 200 ft. deep. The present generating plant of the Jamestown Lighting & Power Company in Race Alley is to be sold.

Pennsylvania Rushing Work on Electric Locomotives.—At the Pennsylvania Railroad shops at Altoona, Pa., work is being pushed rapidly on 42 electric locomotives that are to be used in the New York terminal. The railroad shops are only building the bodies and the cabs of these locomotives and as fast as these are completed they are sent to the shops of the Westinghouse Electric & Manufacturing Company at East Pittsburgh to be fitted out with the electrical equipment. It is now expected that passenger trains will be operated through the Hudson River tunnels some time in July. The service on the Long Island Railroad, through the East River tunnels, will probably be started in May.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Weiser, Idaho; Los Angeles, Cal.; Brodie, Cal.; Sullivan, Ind.; Westfield, Mass.; Springfield, Ill.; Des Moines, Ia.; Spokane, Wash.; Elkhorn, Wis.; Wenatchee, Wash.; Fresno, Cal.; Belleville, Ont., Can.; Calgary, Alta., Can.; Lebanon, Mo.; Sterling, Neb.; Tyndall, S. D.; Sturgis, Mich.; Milnor, N. D.; Martins Ferry, Ohio; Norwood, Ohio; Bridgeport, Conn.; Prince Rupert, B. C., Can.; Ephraim, Utah; Washington, Ga.; Hannibal, Mo.; Rapid City, S. D.; Seattle, Wash., and Bellingham, Wash.

New Railway in Western Illinois.—A new railway bearing the name of Rock Island Southern is soon to be opened. It connects Moline, Rock Island and Davenport on the Mississippi River with Monmouth and Galesburg, Ill., and is about 100 miles long. The office of the new railroad is in Chicago, and Mr. E. C. Walsh is president and Mr. J. A. Hanley is vice-president. The nucleus of the road is an electric line running from Galesburg to Monmouth, which has been now extended to Rock Island. It will be operated with steam locomotives for freight service and electricity for passengers. A branch will extend from Aledo Junction to Aledo.

Allis-Chalmers Gas Engines.—The Allis-Chalmers Company reports that its gas-engine business continues to increase and at present the full capacity of the gas-engine shop is required for gas engines alone. Some of the recent sales are two 18-in. x 24-in. engines with generators, to the Ware County (Ga.) Light and Power Company; one 18-in. x 24-in. engine and generator to the American Car & Foundry Company for its plant at Huntington, W. Va.; three 24-in. x 36-in. engines and generators to the Alpha Portland Cement Company for its new plant at Alsens, N. Y., and three 18-in. x 24-in. engines and generators to the Guanica Centrale Company for a sugar mill in Porto Rico. There are many other propositions under consideration, and it is apparent that the gas engine is now fully as acceptable for power purposes as any other type of prime mover.

Westinghouse Low-Pressure Turbines.—A 750-kw low-pressure Westinghouse steam turbine is being added to the power plant of the Corr Manufacturing Company, East Taunton, Mass., to utilize the exhaust of Corliss reciprocating engines, together with a Westinghouse-Leblanc condenser. The generator is a 940-kilovolt-ampere, turbine type alternator, furnishing three phase, 60-cycle currents at 600 volts. Distribution lines at this voltage supply a number of 100-hp motors in the weave sheds, serving as economical auxiliaries to the older system of belting and lineshaft transmission from the engine to the machines driven.

Inquiry from Barcelona.—Mayor Busse, of Chicago, has received an inquiry from Anglo-Espanola de Electricidad, Pelayo, Barcelona, Spain, asking for information in relation to the possibility of establishing direct commercial relations with electrical concerns in Chicago. The mayor turned over the inquiry to the Chicago Association of Commerce.

Financial.

The Week in Wall Street.

WHEN the rate of discount abroad was suddenly advanced last week and sterling exchange was higher, it began to be evident that gold shipments would necessarily be made. There were some heavy engagements during the latter end of last week, and $500,000 in gold eagles was engaged for shipment to London on April 4. In addition to this, the bank statement showed a loss of $10,176,000 and a cut of $5,845,000 in surplus reserves. Such financial conditions caused considerable liquidation, and a general expectation of an advance in the local money market. On the contrary, rates for money were cheaper April 4 than at any time during the previous month. This is in a large measure due to the very light volume of trading. Liquidation has been in evidence for the past fortnight, and at the present time there is very little trading being done even among the professionals. When the volume of trading is small customers of the banks are fewer. On April 4, as usual, there was more irregularity in the market than on any recent date. This has been the case on Mondays for many weeks, and is attributable to the anxiety felt in the early morning hours, with regard to Supreme Court decisions, and to the relief felt at midday when the announcement is made that no decisions will be handed down. At present the condition of the market is one of procrastination. Outsiders are not buying, and regular traders are making but few commitments. The money market April 4 was as follows: Call 1@3 per cent; 90 days, 4@4¼ per cent. The quotations in the table are those of the close of April 4.

NEW YORK.

	Mar. 28.	Apr. 4.	Shares sold.		Mar. 28.	Apr. 4.	Shares sold.
All.-Ch.	9⅞	10	2,320	Int.-Met., pfd.	56¾	57½	33,250
All.-Ch., pfd.	39*	37⅝	600	Mackay Cos..	89½	89¼*	100
Amal. Cop...	74½	74¾	229,800	Mackay C., p.	77	78*	800
Am. D. T....	20½*	20½*	——	Man. Elev...	137*	136⅝	150
Am. Loc.....	49	50½	5,300	Met. St. Ry..	16*	15*	100
Am. Loc., pfd.	113*	114*	200	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com....	83	83	679,100
Am. T. & T..	140⅛	135½	15,666	Steel, pfd....	119½	119½	10,073
B. R. T.....	76	76½	38,430	W. U. T.....	73⅛	72½	2,210
Gen. Elec....	151	149¼	1,200	West'h., com.	63¼	64¾	19,500
Int.-Met.,com.	22¼	22⅜	22,600	West'h., pfd..	125	125*	200

PHILADELPHIA.

	Mar. 28.	Apr. 4.		Mar. 28.	Apr. 4.
Am. Rys.....	45*	45	Phila. Elec.....	16	15⅝
Elec. Co. of A.....	12*	12⅛*	Phila. R. T.....	21⅛	22½
Elec. St. B'ty.....	60½	60½	Phila. Trac.....	87	87¼
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	49	49½

CHICAGO.

	Mar. 28.	Apr. 4.		Mar. 28.	Apr. 4.
Chi. City Ry.....	185*	185*	Chi. Tel. Co.....	132	139
Chi. Rs., Ser. 1.....	106*	100	Met. El., com.....	16*	16*
Chi. Rs., Ser. 2.....	32*	32*	Met. El., pfd.....	51	51¼*
Com. Edison.....	116⅞	115	Nat'l Carbon.....	114¼	114¼*
Chi. Subways.....	3*	3½*	Nat'l Car., pfd.....	120¼*	120*

BOSTON.

	Mar. 28.	Apr. 4.		Mar. 28.	Apr. 4.
Am. T. & T.....	140¼	135⅜	Mex. Tel.....	4⅞	4⅛
Cum. Tel.....	152⅛*	151⅜	Mex. Tel., pfd.....	6½	6⅛
Edison E., Ill.....	256½	253	N. E. Tel.....	137½	135
Gen. Elec.....	149¾	150	W. T. & T.....	16½*	16½
Mass. E. Ry.....	17¾	18½	W. T. & T., pfd....	89*	86*
Mass. E. R., pfd....	84	85¼			

* Last price quoted.
Shares sold for week of March 28 to April 4.

Financial Notes.

Oregon Electric Railway Company.—With regard to a published report that James J. Hill and interests connected with the Great Northern Railroad Company had taken over the property of the Oregon Electric Railway Company, George B. Moffatt, the president of the company, had this to say: "Neither Mr. Hill nor any one else has purchased our road. Ever since we began to build an electric line in Oregon there have been reports that we have sold out or that we are being built by some other railroad company. I have always taken the position that I would neither affirm nor deny these reports, and so far I never have. I will say this, however, our company has gone so far without outside help and I think it will continue to do so. We have built a line from Portland to Salem, and while it is electrically operated we have equipped it both in track and in rolling stock like a steam railroad. The line is operated in this manner, too. We have regular time tables and run regular trains on schedule. The territory through which our line runs is growing very rapidly and our earnings in 1909 increased about 50 per cent over those of the year previous. It is true that Guy W. Talbot, formerly general manager of our company, has resigned to become president of the Portland Gas Company, but this does not mean that there is any change in ownership. Our line will be extended into other territory as rapidly as developments require."

Amalgamated Copper Dividend.—When the directors of the Amalgamated Copper Company meet next month it is possible that the dividend will be increased from 2 to 3 per cent. This condition has been brought about by the consolidation of Amalagamated interests in the Butte district. The new Butte merger will have a production of about 275,000,000 lb. of copper a year, and it is claimed that with the interests consolidated as they now are this copper can be produced at 9 cents per lb. On a 13½-cent market the earnings of the Anaconda consolidation would be $12,375,000 a year.

New Haven Railroad Not Buying Power Plants.—President Charles S. Mellen, of the New York, New Haven & Hartford Railroad Company, denies that his company has prepared plans for the construction of a hydroelectric plant on the Saco River, in Maine. It was said that the railroad company contemplated building a plant at which car and repair shops would be located. It is said that a 60-ft. dam was contemplated at Bonny Eagle, which would impound 1000 acres of water and would produce about 6000 hp.

Hoosac River Electric Light & Power Company.—The Public Service Commission of the Second District of New York has authorized the Hoosac River Electric Light & Power Company to issue capital stock to the amount of $15,000 to be sold at not less than par. The proceeds of this issue are to be used for discharging indebtedness incurred in erecting the plant at Valley Falls. The company was also given authority to exercise its franchise in the village of Schaghticoke, N. Y.

American Telephone & Telegraph Company.—The American Telephone & Telegraph Company has filed with the Secretary of State at Albany a certificate for the increase of the capital stock of the company to $500,000,000. This makes the company second to the United States Steel Corporation in size. This increase in stock will not be immediately issued, but will be held in reserve for the conversion of bonds and other purposes as the needs of the company require.

Gray's Harbor Railway & Light Company.—Sanderson & Porter, of 52 William Street, New York, have acquired control of the Gray's Harbor Railway & Light Company, of Aberdeen, Wash. This company has about 10 miles of railway and owns 15 cars. It has a steam power station at Aberdeen and owns an amusement park. The company also furnishes the entire lighting business for the city of Aberdeen, 10,000 population, and the adjacent territory.

Hudson & Manhattan and Pennsylvania Railroads.—The Pennsylvania Railroad Company, in its annual report, has outlined the traffic arrangement which it has made with the Hudson & Manhattan Railroad Company. This provides that every passenger coming into the Pennsylvania station at Jersey City shall be carried without extra charge to the Cortlandt Street station of the Hudson & Manhattan company. In addition, the report says that the tunnel system will be extended through Jersey City westward to Summit Avenue, where connections will be made with the Pennsylvania tracks, and that the Pennsylvania will be electrified from that connection to Harrison, and a new branch will be constructed into Park Place, Newark. The report says that a joint rapid transit electric service will then be provided between the Cortlandt Street and Park Place stations.

Anaconda Copper Stock Increase.—At a special meeting of the stockholders of the Anaconda Copper Company last week it was voted unanimously to increase the company's capital stock from 1,200,000 shares to 6,000,000 shares. These additional shares will be used to take over the various properties in the Butte district. The majority of the companies taken over are owned almost entirely by the Amalgamated Copper Company. With the new shares of Anaconda thus acquired, and with its previous holdings, the Amalgamated will own 3,075,000 shares in the Anaconda Company, or almost three-quarters of the total outstanding stock. There is little significance in this transaction beyond the fact that the Amalgamated is consolidating the management of many of its properties into one corporation.

Phelps, Dodge & Company's Copper Sales.—The annual report of Phelps, Dodge & Company shows that that concern marketed, during the year 1909, 185,033,415 lb. of copper on account of its subsidiaries and other producers. The income account shows dividends received from subsidiary companies, $5,769,354; miscellaneous earnings, $256,385; expenses and taxes, $182,529; dividends, 5,396,625, leaving a surplus of $446,559. President James Douglas of the company says that during the year great improvements have been made in the plants of the company, all tending to lower the cost of operation, and that these improvements have all been paid for out of the company's treasury.

Marconi Wireless Telegraph Company.—A special meeting of the stockholders of the Marconi Wireless Telegraph Company has been called for April 18 to vote upon the proposition of reducing the capital stock from $6,650,000 to $1,662,500. This will be accomplished by reducing the par value of each share from $100 to $25. This reduction is being made in order to reduce the taxation charges that are now imposed. The company will save $4,500 per year by this reduction. Of the capitalization $5,494,269 is carried in the balance sheet as "patents and rights."

Philadelphia Rapid Transit Company.—The long-continued strike of the employees of the Philadelphia Rapid Transit Company will probably increase very greatly the deficit in the report of the company for the year ending June 30, 1910, which is its fiscal year. It is said that the company has sustained approximately a loss of 800,000 passengers per day. Previous to the present trouble the company was making new records. For several months the gross earnings had exceeded those of the corresponding months in the previous year.

Pacific Telephone Bonds.—N. W. Harris & Company and Bond & Goodwin, of New York, are offering at 98½ and interest $6,000,000 first mortgage 5 per cent bonds of the Pacific Telephone & Telegraph Company. This offering includes the $3,000,000 of bonds sold to these bankers about two weeks ago. The report of the company for 1909 showed a surplus, after paying interest on $29,000,000 of bonds, of $1,653,159. Application will be made to add the present issue to the amount of bonds already listed on the New York Stock Exchange.

Canadian Westinghouse Company.—At the annual meeting of the Canadian Westinghouse Company held in Hamilton, Ont., last week, the report showed that the sales for the year were larger than they had been for any year since the company had been in business. The balance sheet showed $2,766,488 as the value of the property and plants. The profits last year were $498,379 and the dividends paid amounted to $261,540.

Denver Gas & Electric Stock Sales.—There were sales made last week in the Denver market of the stock of the Denver Gas & Electric Company at $155 per share. While there was not much stock in the market, what little that was offered was greedily taken by buyers. The increase in the earnings of the company has been very marked and there seems to be a good demand for the stock.

Listings on the Stock Exchange.—Among the listings on the New York Stock Exchange last week were $500,000 first mortgage bonds of the Syracuse Lighting Company; $12,500,000 New York Telephone Company first mortgage 4½ per cent bonds and $10,000,000 Lackawana Steel Company bonds.

American Cities Railway & Light Company.—The report of the American Cities Railway & Light Company for 1909 shows total earnings of $714,245. This is an increase of more than $160,000. After paying the full 6 per cent dividend the company added $2,769 to its surplus account.

DIVIDENDS.

American Power & Light Company, preferred, quarterly, 1½ per cent, payable April 1.

Boston Suburban Electric Companies, quarterly, $1 per share, payable April 15.

Cincinnati, Newport & Covington Light & Traction Company, preferred, quarterly, 1⅛ per cent, common, quarterly, 1 per cent, both payable April 15.

Manchester (N. H.) Traction Light & Power Company, quarterly, $2 per share, payable April 15.

National Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable April 1.

Pacific Telephone & Telegraph Company, preferred, quarterly, 1½ per cent, payable April 15.

Philadelphia Company, quarterly, 1½ per cent, payable May 2.

Standard Underground Cable Company, quarterly, 3 per cent, payable April 10.

Twin City Rapid Transit Company, quarterly, 1½ per cent, payable May 2.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company:					
Year 1909	$714,245	$28,082	$686,163	$683,393	$ 2,769
Year 1908	547,897	29,501	518,396	414,366	104,036
Aurora, Elgin & Chicago Railroad Company:					
February, 1910	103,399	63,267	40,132	32,153	7,979
February, 1909	94,335	58,219	36,116	28,260	7,856
Brooklyn Union Gas Company:					
Year 1909	8,359,484	5,542,653	2,816,829	1,200,693	1,639,999
Year 1908	7,949,729	6,298,469	1,651,260	995,325	751,152
Canadian Westinghouse Company:					
Year 1909	498,379	70,000	428,379	261,540	166,839
Year 1908	326,377	30,000	290,377	249,937	40,440
Detroit United Railway Company:					
February, 1910	607,577	398,422	209,155	159,140	62,417
February, 1909	519,592	348,711	170,881	154,457	27,146
Kansas City Railway & Light Company:					
February, 1910	553,543	286,728	266,815	150,582	116,233
February, 1909	519,720	294,859	224,862	153,141	71,721
Michigan State Telephone Company:					
Year 1909	3,819,630	2,994,379	825,251	443,260	381,991
Year 1908	3,413,280	2,501,851	911,429	417,595	464,605
New York Edison Company:					
Year 1909	16,545,860	8,552,948	7,992,912	3,280,503	4,719,807
Year 1908	15,228,680	9,087,680	6,141,035	3,250,767	3,904,704
Syracuse Lighting Company:					
Year 1909	1,240,774	734,117	506,657	313,980	192,081
Year 1908	1,105,409	677,648	427,761	310,000	117,161
Twin City Rapid Transit Company:					
February, 1910	536,954	281,617	255,337	140,229	115,108
February, 1909	483,101	273,784	209,317	133,962	75,355

General News

Construction News.

ATHENS, ALA.—Bonds to the amount of $3,500 have been voted, the proceeds to be used for remodeling the municipal electric light plant and constructing sewers.

DADEVILLE, ALA.—The Russell Manufacturing Company is negotiating with John W. Pace for the purchase of water rights owned by him on Big Sandy Creek, nine miles south of Dadeville. The promoters, it is said, propose to develop the water power to generate electricity, which will be transmitted to Alexander City, about 11 miles distant, to be used for manufacturing purposes.

FLORENCE, ALA.—Thurston H. Allen is reported to be interested in a project to construct an electric railway from Florence to Huntsville, a distance of about 75 miles. This plan includes the development of water power in the Tennessee River to generate electricity to operate the proposed railway.

FOLEY, ALA.—The Alabama Telephone & Telegraph Company, recently organized, proposes to construct telephone lines to Galesburg, Seminole and Somerdale. Ellis L. Munner is president.

GADSDEN, ALA.—The Alabama City, Gadsden & Attalla Railway Company is contemplating building an extension to North Gadsden. It is reported that the company will also construct a railway to Bellevue Hotel and Nocaluiu Falls.

GUNTHERSVILLE, ALA.—The Gunthersville Realty Company will soon award contracts for the construction of an electric light and power plant, to cost about $10,000. W. J. Wilson, of Gunthersville, Ala., engineer, will have charge of the work.

HOLBROOK, ARIZ.—Local business men are reported to be organizing a company to construct a dam across the Little Colorado River, four miles above Holbrook, the water to be used for irrigation and power purposes. A storage reservoir is also to be erected.

BENTON, ARK.—Work has commenced on the construction of the power house of the Benton Electric Light Company.

LITTLE ROCK, ARK.—The Fort Wayne Electric Works, of Fort Wayne, Ind., has secured the contract for equipment of the municipal electric light plant, for $39,500. The plant will have sufficient output to provide for 1000 lamps. The street lighting system will utilize 500 lamps. A new street lighting system is to be installed.

MORRILTON, ARK.—The local electric light plant, owned by William H. Ashley, has been purchased by W. L. Morse. The new owner, it is said, will establish a 24-hour service at once.

VAN BUREN, ARK.—Application has been made to the City Council by the Fort Smith Light & Traction Company, of Fort Smith, Ark., for a franchise to construct and operate an electric railway over certain streets in Van Buren.

BRODIE, CAL.—A new electric power plant is being erected near Brodie by the W. H. Metson interests. The plant will be equipped with a 1500-kw Allis-Chalmers generator direct connected to a turbine water wheel, operating under a head of about 350 ft. Electricity generated at this station will be transmited to Brodie and to mines in Nevada.

COLUSA, CAL.—Surveys are being made by the Pacific Gas & Electric Company for a route for a new pole line from Marysville to Meridian, thence to Colusa. The wires will carry 60,000 volts and will furnish electricity for the Northern Electric Railway and for lamps in this city. The town will be rewired.

EASTON, CAL.—A franchise has been granted by the Board of Supervisors to Hall C. Ross to construct and operate an electric railway in Easton, Cal.

FRESNO, CAL.—Preparations are being made by the San Joaquin Light & Power Company for the construction of a large power plant on the north fork of the San Joaquin River, near Fresno, which will involve an expenditure of about $1,250,000. The new plant will have an output of about 22,000 hp and will supply electricity for lamps and motors in Fresno, Madera, Fowler, Hanford, Selma and as far south as Coalinga and the adjacent oil fields. The immediate work includes the construction of a dam 125 ft. high, which will form a lake 16 miles in circumference.

LONG BEACH, CAL.—The Southern California Edison Company has secured all the property necessary in this city on the inner harbor for its proposed power plant, work on construction of which will begin as soon as possible. The company proposes to spend $2,000,000 on the initial equipment and will eventually expend $8,000,000. The plant will ultimately have an output of 250,000 hp.

LOS ANGELES, CAL.—The Board of Supervisors has ordered that the Bell Lighting district be formed, which will take in portions of Fruitland and Florence districts.

LOS ANGELES, CAL.—We are informed that the Los Angeles & Mount Washington Railway Company will place contracts within 60 days for the construction of a small power plant. John A. Rivers is superintendent.

LOS ANGELES, CAL.—The Board of County Supervisors has granted the Southern California Edison Company a franchise granting the company the privileges previously held by the Edison Electric Company and taking in additional streets and alleys, for which the company paid the sum of $1,000.

LOS ANGELES, CAL.—Work has commenced on the construction of the large irrigation and power project of the Consolidated Reservoir & Power Company, of Los Angeles, Cal. The company proposes to divert the water of the Whitewater River, at an elevation of 7000 ft. in the San Bernardino Mountains, to irrigate apple lands in Banning. Six miles of pipe line will be laid. Power houses will be erected to generate electricity. H. Edwin Moore, of Los Angeles, is president of the company, and W. B. Scarborough, secretary.

MARYSVILLE, CAL.—Notice of appropriation of two water rights has been filed by Newton C. Cleveland, of the Yuba Consolidated Goldfields Company. The claims call for 20,000 in. of water in Yuba River, opposite Da Guerre Point, to be utilized for generating electricity, irrigation, industrial and agricultural purposes. The water is to be diverted by a dam, thence to ditches, flumes and pipes.

OAKLAND, CAL.—The City Council has adopted the resolution to pass an ordinance requiring all electric wires on Twenty-fourth Street, between Webster Street and Harrison Boulevard placed underground.

ONTARIO, CAL.—Frank J. Kimball, of Los Angeles, Cal., is reported to be making investigations in connection with a water-power development on a tract of land in Ontario, which the city proposes to purchase for a park. The erection of a pumping plant is contemplated, to cost about $14,000.

SACRAMENTO, CAL.—The great Western Power Company has awarded a contract to the McGillvray Construction Company for the erection of a substation at Eighth and R streets in this city. The station is to be built of concrete and will be the distributing station for the Great Western Power Company in this city.

SACRAMENTO, CAL.—Application has been filed with the Board of Supervisors by Joseph Shaw for a franchise to erect transmission lines along the county roads for the purpose of supplying electricity for lamps, heat and motors. Electricity for the system will be supplied by the Great Western Power Company, which will be distributed particularly in the suburban field of Sacramento, including Oak Park, Curtis Oaks, Highland Park and Oak Grove.

WOODLAND, CAL.—The Vallejo & Northern Railway Company, of Vallejo, has been granted a franchise by the Board of Trustees to construct and operate an electric railway in Woodland.

GRAND VALLEY, COL.—It is reported that the City Council has decided to take over the water and electric light franchise of the local company and install a municipal plant at a cost of about $25,000 for each service.

MONTROSE, COL.—Arrangements are being made by the Colorado Telephone Company for the erection of a new toll line from Telluride to the west end of Montrose County. The line will be about 40 miles in length and will cost about $14,000.

TRINIDAD, COL.—The City Council is reported to be considering the question of remodeling the street lighting system.

BRIDGEPORT, CONN.—The Connecticut Company is contemplating increasing the output of its power plant in Bridgeport to 5000 kw. The company operates the street railway system owned by the New York, New Haven & Hartford Railroad Company in the southern part of Connecticut.

NEW CANAAN, CONN.—The Housatonic Power Company, which has taken over the lighting and commercial power interests of the Connecticut Company, is rebuilding the transmission line from Norwalk to New Canaan. The present line will be replaced with heavier wire.

TARIFFVILLE, CONN.—Orders have been placed by the Edward Balf Company, of Tariffville, Conn., for a large supply of stone-crushing machinery to be erected in this town. The equipment will include four Gates gyratory breakers and a Gates patent revolving metal screen, which will be driven by 100-hp, Allis-Chalmers, 60-cycle, two-phase, 440-volt, 720-r.p.m. induction motor fitted with dust-proof bearings.

BOCA GRANDE, FLA.—It is reported that the Charlotte Harbor & Northern Railway Company is contemplating the installation of an electric power plant to furnish electricity to operate a phosphate elevator. L. M. Fouts is general manager.

GREEN COVE SPRINGS, FLA.—We are informed that it is proposed to build a municipal electric light plant in Green Cove Springs, to cost about $10,000, bids for construction of which will be asked for in the near future. C. E. Lepford is town clerk.

CEDARTOWN, GA.—The Gainesboro Telephone Company is planning to extend its telephone line through to Collard Valley.

MACON, GA.—The City Council is considering a novel advertising proposition submitted by the Central Georgia Power Company, of Macon, Ga. It is proposed to erect a steel tower, at least 150 ft. high, at the

highest point in the city, upon which will be placed an electric sign, carrying about 1500 incandescent lamps. The company has offered to furnish electricity free of charge if the city will erect the tower.

VALDOSTA, GA.—The Georgia Southern & Florida Railway Company has recently purchased a site in Valdosta, Ga., on which, it is reported, it will erect a foundry, boiler shop, machine shops and an electric power plant. The entire plant will be equipped for electrical operation. The main office of the company is located at Macon, Ga.

WASHINGTON, GA.—The Washington Lumber & Power Company, recently incorporated with a capital stock of $50,000, has purchased a site on Liberty Street, on which it proposes to erect an electric power plant, planing mill, drykiln, shops and storage room. The power plant will furnish electricity to operate the machinery in the buildings and also for commercial purposes in Washington. A dust collector and blower system, for blowing shavings (for fuel) from lumber plant to power house, will be installed. P. J. Holliday and others are interested in the project.

WAYCROSS, GA.—The Waycross & Florida Central Company has filed application for a charter for the purpose of constructing an electric railway in Georgia. 70 miles in length. The distance the railway is to be extended into Florida has not yet been decided. The incorporators are: C. J. Haden, C. H. Johnson, W. C. Dodson, Charles E. Johnson, of Atlanta, Ga.; J. S. Blalock, of Jonesboro, Ga.; G. W. Deen and W. E. Sirman, of Waycross, Ga.

WAYCROSS, GA.—The Ware County Light & Power Company has contracted with the Allis-Chalmers Company, of Milwaukee, Wis., for new equipment for its plant, which will include two 18-in. x 24-in., single-tandem gas engines, each direct connected to a 250-kva, three-phase, 60-cycle, 2300-volt, 200-r.p.m. alternator. A motor generator set and two direct-current generators driven by small gas engines will provide for excitation. An induction motor will drive an air compressor. Gas will be supplied by producers.

COTTONWOOD, IDAHO.—It is reported that Walter H. Hill, of Grangeville, Idaho, is negotiating for the purchase of the Cottonwood electric plant. Mr. Hill is planning to erect a large power plant on the Clearwater River, a few miles from Grangeville.

GRANGEVILLE, IDAHO.—The City Council has granted Walter H. Hill a 30-year franchise to construct and operate an electric light and power system in Grangeville. Mr. Hill proposes to erect a power plant on the Clearwater River, five miles distant. The proposed plant will cost about $100,000 and develop about 400 hp.

VOLLMER, IDAHO.—Steps have been taken by W. J. Ramey and others of Vollmer, for the organization of a new power company to be known as the Craig Mountain Light & Power Company. The proposed company has a power site in Lawyer's Canyon, and will be capitalized at $50,000.

WEISER, IDAHO.—The Council Mesa Orchard Company, composed of Eastern capitalists who own about 20,000 acres of orchard land between Cambridge Council and Indian Valley, is contemplating installing an electric plant on the middle fork of Weiser River, which will furnish energy to operate an electric railway from the property of the company to a connection with the Pacific & Idaho Northern, at Goodrich, a distance of 25 miles.

CHICAGO, ILL.—The Hammond, Whiting & East Chicago Electric Railway Company is preparing to commence work on the construction of its proposed extension between Hammond and Harvey. D. M. Cummings, of Chicago, Ill., is president.

GENESEO, ILL.—The Rock River Traction Company has awarded the contract for the construction of its proposed electric railway from Princeton to Rock Island to the Northwestern Engineering & Construction Company. Work on construction of the road will commence within 30 days.

LA SALLE, ILL.—The Marquette Cement & Manufacturing Company is contemplating the installation of a 1200-kw, direct-current generator, which will be driven by a cross-compound Corliss engine in its power house at La Salle, Ill.

McLEANSBORO, ILL.—The Indiana Oil & Coal Belt Railroad Company has awarded the contract for the construction of its proposed electric railway, which is to connect Terre Haute, Ind., Robinson, Olney, Fairfield, McLeansboro, Marion and Cairo, Ill. The power plant and repair shops will be located at McLeansboro. James R. Campbell, of McLeansboro, Ill., is president.

MORRIS, ILL.—The Economy Light & Power Company, of Joliet, Ill., is reported to have purchased the plants of the United Electric Company and the Morris Gas Light Company in Morris.

OLNEY, ILL.—Sealed bids will be received by the city of Olney, Ill., until April 11, for lighting the streets of the city, according to plans and specifications on file at the office of the city clerk. J. D. Porter, D. Z. Vernor and F. E. Edminston are members of the committee.

SPRINGFIELD, ILL.—Extensive improvements and extensions will be made to the system of the Illinois Traction Company during the coming spring and summer, which will involve an expenditure of about $500,000. Among the improvements contemplated is the remodeling of the central power station in Springfield, to which a second story will be added.

TAMPICO, ILL.—The capital stock of the Dixon, Rock Falls & Southwestern Electric Railway Company has been increased from $50,000 to $300,000. The company is constructing an electric railway from Sterling to Moline. Track has been laid from Tampico to Yorktown.

BLUFFTON, IND.—Preparations are being made by the Bluffton, Geneva & Celina Traction Company to commence work soon on its proposed electric railway between Bluffton, Ind., and Celina, Ohio.

BREMEN, IND.—It is reported that 500-hp return tubular boilers with auxiliary equipment will be purchased in the near future for the municipal electric power and pumping station.

FARMLAND, IND.—Application has been made to the City Council by F. G. Mills and P. M. Bly for a franchise to install and operate electric light and water systems in Farmland.

INDIANAPOLIS, IND.—The Sanburn-Marsh Electric Company has changed its name to the Sanborn Electric Company, H. B. Marsh retiring. G. M. Sanburn is president of the company.

INDIANAPOLIS, IND.—The capital stock of the Beech Grove Traction Company has been increased from $10,000 to $100,000. The company proposes to construct an electric railway connecting Beech Grove and Indianapolis. W. H. Ogan is president.

INDIANAPOLIS, IND.—The Circle Merchants Association has decided to place a special lighting system around Monument Square, which will consist of a number of 640-cp arc lamps, six to the square. R. E. Gregg, Hubert Keller and Norman Perry have charge of the matter and will decide upon the type of lamp to be used.

LAFAYETTE, IND.—The additions to be made to the shops of the Chicago, Indianapolis & Louisville Railway Company in connection with the repair plant at Lafayette, will be equipped for electric motor drive. It will be necessary to enlarge the power plant, and steam turbine units may be installed.

MUNCIE, IND.—The Muncie Gear Works Company, recently incorporated with a capital stock of $250,000, is planning to install a large manufacturing plant, which will be equipped for electric motor drive throughout. H. L. Warner is president of the company.

SEYMOUR, IND.—Bids will be received by John Hauenschild, city clerk, until April 21, for lighting the streets and for an exclusive franchise to establish an electric light and power plant in Seymour. Plans and specifications can be obtained from the city clerk, Seymour, Ind., or McMears & Tripp, consulting engineers, 710 Majestic Building, Indianapolis, Ind.

SULLIVAN, IND.—Announcement has been made by Frank R. Fisher, general superintendent of the Alleson Coal Mining Company, that the mines owned and operated by the company would be equipped to be operated by electricity during the coming summer. The company is now in the market for equipment for the same. The mines will also be lighted by electricity.

COUNCIL BLUFFS, IA.—Arrangements are being made by John G. Woodward & Company, of Council Bluffs, Ia., for a large addition to their factory, which, it is understood, will be equipped for electric-motor drive. Four boilers and other equipment will be required.

DES MOINES, IA.—We are informed that as soon as preliminary work is completed the Omaha, Council Bluffs & Sioux City Railroad Company will commence work on construction of its proposed electric railway, which is to extend from Omaha to Council Bluffs and to Sioux City, 100 miles in length. The company will build a hydraulic power plant, which will furnish electricity for operating the railway and also for lamps. M. H. Miller, of Des Moines, Ia., is president.

SIGOURNEY, IA.—At an election held March 28 the citizens voted to grant a franchise to J. F. Bray to construct and operate an electric light plant in Sigourney, Ia.

HOPE, KAN.—The question of establishing a municipal electric light plant is under consideration. A committee, consisting of Dr. Entz, Harry Kock and Clarence Stagg, has been appointed to make investigations regarding the same.

LEAVENWORTH, KAN.—The Helmers Manufacturing Company is reported to have placed contracts for an engine-driven generator set, motors, etc., in connection with equipping its plant for electrical operation.

LINCOLN, KAN.—The citizens on March 24 voted in favor of the proposition to issue $12,000 in bonds, the proceeds to be used for the purchase of an engine for the municipal electric light plant.

DONALDSONVILLE, LA.—A 99-year franchise has been granted to John Marks and associates to construct and operate an electric railway on the batture of Bayou Lafourche from Donaldsonville to Lockport.

LEWISTON, MAINE.—Announcement has been made by W. S. Libbey and H. M. Dingley, of Portland, Me., who have purchased the controlling interest in the Portland, Gray & Lewiston Railroad, that work will be started on the proposed railway between Auburn and Portland in the near future.

AMESBURY, MASS.—The Amesbury Electric Light Company has applied to the State Board of Gas and Electric Light Commission for permission to issue $20,000 in additional capital stock, the proceeds to be used for extensions and improvements to the system.

BOSTON, MASS.—The contract for installing the electric system in the Abraham Lincoln School has been awarded to Edwin C. Lewis for $11,108.

BOSTON, MASS.—Bids will be received until April 30 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for condenser,

piping and pumps to be erected in the central power plant at the navy yard, Boston, Mass. William M. Smith is acting chief of bureau.

FALL RIVER, MASS.—Extensive changes are contemplated by the Fall River Electric Light Company in the lighting of North and South Main streets, plans for which have been submitted to the committee on street lighting.

NORTH ADAMS, MASS.—The Boston & Maine Railroad Company is making arrangements to install a motor-driven fan to improve the ventilation of the Hoosic tunnel. Orders for electrical equipment have been placed with the Allis-Chalmers Company, of Milwaukee, Wis., and include a 150-kva, 2300-volt, three-phase, 60-cycle, 900-r.p.m., synchronous motor to be belted to the fan. Electricity will be received at 6600 volts and stepped down to 2300 volts in three 50-kva, oil-filled, self-cooled transformers. Excitation will be furnished by a 5-kw belted exciter. A switchboard is provided for controlling the apparatus.

ROWLEY, MASS.—The contract for installing the municipal electric lighting system has been awarded to the J. J. Merrill Construction Company, of Newburyport, Mass.

WESTFIELD, MASS.—Plans are being prepared by the Western Massachusetts Street Railway Company for extensive improvements and extensions to its system, which will involve an expenditure of about $50,000 and include an addition to its power house, an extension to the Pope Manufacturing Company's factory, replacing wooden poles with iron poles and laying new rails in Elm Street. The equipment for the power house will include new boilers and the installation of an additional engine and generator. L. S. Storrs, of Springfield, Mass., is president of the company.

DETROIT, MICH.—The American Car & Foundry Company is reported to have decided to erect another large foundry in Detroit this year. It is understood that it is to be equipped for electric motor drive throughout.

STURGIS, MICH.—Sealed bids will be received until April 12 by M. E. Aulsbrook, president of Board of Public Works, Sturgis, Mich., for one vertical, hydroelectric, direct-connected unit with a rating of 600 kw, consisting of one hydraulic, vertical, reaction turbine, and one 600-kw, alternating-current generator; one 45-kw, 125-volt, vertical exciter, comprising turbine, shaft and exciter generator; one hydraulic governor for alternating-current generator unit; six oil-cooled, alternating-current, single-phase, 60-cycle transformers for changing current from 2300 to 23,000 volts; one three-panel switchboard with equipment for handling output of above apparatus. Proposals will be considered for all or any of the above apparatus. For specifications, blank forms and other information, address J. S. Flanders, manager. G. S. Williams, of Ann Arbor, Mich., is consulting engineer.

ANOKA, MINN.—At an election to be held April 19 the proposition to issue $45,000 in bonds, for the construction of a dam on Rum River, and bonds to the amount of $15,000, for erection of substations, pumps, transformer stations, etc., in connection with the municipal electric light and water plants, will be submitted to a vote.

BEROUN, MINN.—The Hinckley-Kroschel Company is contemplating extending its telephone line east for a distance of about 15 miles.

CROOKSTON, MINN.—The Crookston Water Works, Power & Light Company will resume work on the construction of its proposed 3500-hp plant to be erected near Huot, on the Red Lake River, as soon as the frost is out of the ground. It is expected to have the plant completed by Nov. 1. Electricity generated at the plant will be transmitted to Crookston, East Grand Forks and Grand Forks.

DULUTH, MINN.—The contract for generators, motors, etc., for the Washington Grade and Manual Training School has been awarded to the Fort Wayne Electric Works, Fort Wayne, Ind., for $6,600.

MINNEAPOLIS, MINN.—The Northwestern Consolidated Milling Company, of Minneapolis, Minn., is contemplating making extensions to its power plant. It is understood that considerable transmission machinery will be required.

MONTGOMERY, MINN.—Application has been made by S. A. Vopatek, of New Prague, and A. P. Washa for a franchise to install an electric light plant in Montgomery.

MORTON, MINN.—Application has been made by the Wherland Electric Company for a franchise to install an electric light plant in Morton.

MOUNTAIN LAKE, MINN.—We are informed that the installation of an electric light plant is not contemplated in Mountain Lake, as reported in these columns in the issue of March 24.

PELICAN RAPIDS, MINN.—The question of purchasing new equipment for the municipal electric plant, at a cost of $2,000, is under consideration.

PINE RIVER, MINN.—It is reported that Arvig Brothers have withdrawn their application for a franchise to install an electric light plant in Pine River.

ROBBINSDALE, MINN.—The installation of an electric light plant in Robbinsdale is under consideration. John Trump is reported to be interested in the project.

SAUK CENTER, MINN.—The Northwestern Telephone Company, it is said, will soon commence work on the reconstruction of its local telephone plant.

HANNIBAL, MO.—The Hannibal Electric Light & Railway Company is reported to be contemplating the installation in the near future of an engine and generator, with a rating of about 500 hp.

HANNIBAL, MO.—M. S. Martin, of Hannibal, Mo., is reported to be preparing plans for the installation of a private power plant in Dallas, Tex., the equipment of which will include two horizontal return tubular boilers of 150 hp each; one 150-kw engine-driven generator set for direct current, heater, feed pump, house pump and auxiliary equipment.

KANSAS CITY, MO.—The City Council is considering the question of extending the territory and lengthening the time of the franchise held by W. M. Hall. The Utilities Commission has recommended that an eight-year franchise covering the territory bounded by Main Street, Grand Avenue, Seventh and Tenth be granted to Mr. Hall. The latter has asked the comimttee to enlarge the territory and lengthen the life of the franchise to 26 years.

LEBANON, MO.—At an election held March 29 the citizens voted in favor of the proposition to issue $20,000 in bonds, the proceeds to be used for improvements to the municipal electric light and water-works plant. E. F. Stebbins is engineer in charge.

BOZEMAN, MONT.—Preparations are being made by the Gallatin Valley Electric Railway Company to extend its railway from Bozeman Hot Springs to Three Forks, a distance of 27 miles. The cost of the extension is estimated at $650,000.

BEATRICE, NEB.—G. W. Steinmeyer has filed a suit in the district court asking for water rights and for permission to erect a dam in the Blue River, at the Lash Farm, about half way between Beatrice and Holmesville. He proposes to utilize the water power to generate electricity for transmission to Beatrice to be utilized for lamps and motors.

CROFTON, NEB.—The contract for the construction of the power house for the proposed electric light plant and water-works system is reported to have been awarded to O. R. Wilson.

STERLING, NEB.—We are informed that the Drummond Electrical Company is planning to construct an electric plant in Sterling, to cost about $18,000. William Drummond is manager. E. W. Tatum, of Sterling, is engineer.

TRENTON, N. J.—Tentative plans have been adopted for the establishment of a "Great White Way" in the central part of the city, which call for the erection of 121 lamp-posts, each carrying two 250-watt lamps. Sample posts and lamps are to be erected and, after the lamps have been tested, a meeting will be called at which estimates of the cost will be submitted by the J. L. Mott Company for furnishing the posts and the Public Service Corporation of New Jersey for maintenance.

CARLSBAD, N. M.—It is reported that a company has been organized by Roswell capitalists for the purpose of constructing an electric railway from Carlsbad to Roswell.

ALBANY, N. Y.—Nygren, Tenney & Ohmes, of New York, N. Y., have been engaged by the state architect to prepare plans for the lighting and power plant for the state buildings in Albany.

ALSENS, N. Y.—The Alpha Portland Cement Company is constructing a new cement plant at Alsens, N. Y., which will be equipped for electrical operation. The contract for the entire equipment has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis., and includes three 24-in. x 36-in., single-tandem gas engines, each direct connected to a 530-kva, 480-volt, 60-cycle, three-phase, 150-r.p.m. alternator. A motor generator set will supply direct current and belted exciters will furnish excitation. A six-panel switchboard will be installed. The air compressor will be driven by vertical gas engine. Gas for engines will be supplied by producers. Cooling water will be circulated by a motor-driven pump.

BINGHAMTON, N. Y.—The City Council has appropriated $700 to secure the services of a consulting engineer in connection with the investigation of establishing a municipal electric light plant.

BINGHAMTON, N. Y.—In the annual report submitted by Dr. Charles G. Wagner, superintendent of the Binghamton State Hospital, in addition to several other appropriations, has recommended and requested an appropriation of about $75,000, to be used for repairing and improving the electric plant, for automobile truck, a power pump and other additions to the present equipment.

JOHNSTOWN, N. Y.—The Fulton County Gas & Electric Company has applied to the Public Service Commission, Second District, for permission to issue $99,000 in bonds, the proceeds to be used for extensions and improvements to its plant and distributing system. The company operates plants at Johnstown and Gloversville, N. Y.

LONG ISLAND CITY, N. Y.—Bids will be received by Lawrence Gresser, president, Borough of Queens, until April 12, for furnishing and installing combination electric and gas lighting fixtures in the Queens County court house, Long Island City, N. Y.

NEW YORK, N. Y.—The Ray Consolidated Copper Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for four horizontal, twin-tandem, triple-expansion, heavy-duty engines for its plant at Hayden Junction, Ariz. The engines will be direct connected to an Allis-Chalmers 2200-kva, three-phase, 60-cycle, 6600-volt, 100-r.p.m. alternator.

NEW YORK, N. Y.—The Guanica Centrale Company, which controls several of the largest sugar plantations in Porto Rico, is now purchasing power and sugar machinery for a new mill. The Allis-Chalmers Company, of Milwaukee, Wis., has received the contract for power equipment, which includes three 18-in. x 24-in., single-tandem gas engines, each direct connected to a 250-kva, three-phase, 50-cycle, 320-volt, 200-r.p.m. alternator. Each unit will be supplied with a belt-driven exciter. A nine-panel

switchboard will hold controlling apparatus. Gas will be supplied from three producers rated at 900 hp.

RAVENA, N. Y.—The State Telephone Company, of Ravena, N. Y., recently incorporated, will absorb the property of the Ravena & Medway Telephone Company. It is said that the new company will make extensions to the present system, including the erection of a cable line from Holliday's corner in Ravena, to Main Street, Coeymans.

ROCHESTER, N. Y.—Plans are being made by the Buffalo, Rochester & Pittsburg Railway Company to utilize electricity in its local yards. A new electric crane will be installed to handle the freight, to replace the hand cranes now in use.

RUSSELL, N. Y.—The citizens of Russell are negotiating for the installation of an electric lighting system. Power is to be secured from the Grasse River. W. G. Popole, of Hermon, N. Y., is behind the project.

SCHAGHTICOKE, N. Y.—The Public Service Commission, Second District, has authorized the Hoosac River Electric Light & Power Company to issue capital stock to the amount of $15,000, to be sold at not less than par, the proceeds to be used for discharging indebtedness incurred in erecting its plant at Valley Falls, and extensions and further construction in that village, and for necessary equipment for a distributing sytem in Schaghticoke. The company also received authority to exercise its franchise in the Village of Schaghticoke, granted by the Board of Trustees.

GRAHAM, N. C.—The River Falls Cotton Mills Company has engaged the Hydraulic Properties Company, of New York, N. Y., to take charge of the engineering and construction of the dam, power house, concrete steel highway bridge and 10,000-spindle cotton mill. Work will soon commence on construction of the plant. J. W. Menefee is president and treasurer.

GREENSBORO, N. C.—The special committee appointed by the Board of Aldermen to look into the question of establishing a municipal electric light plant has reported in favor of the proposition.

MILNOR, N. D.—The Milnor Auto & Electric Company is reported to be contemplating the installation of an electric light plant with sufficient output to supply from 500 to 1000 lamps.

TOWNER, N. D.—The citizens are considering the question of installing an electric light plant in Towner.

AKRON, OHIO.—The Quaker Oats Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for the remainder of motor equipment for its new cereal factory being erected in Akron. The contract includes 19 squirrel-cage induction motors, ranging in size from 10 hp to 75 hp. The generating equipment for the factory was furnished by the Allis-Chalmers Company.

CINCINNATI, OHIO.—It is reported that the Hisey-Wolf Company, manufacturer of portable electrical tools and grinders, is planning to erect a new factory, to be ready for operation this fall. The proposed plant will be equipped for electric motor drive throughout. Walter J. Friedlander is president of the company.

CINCINNATI, OHIO.—Plans have been completed for the construction of the new factory of the John B. Morris Machine Tool Company, bids for which will soon be called for. The plant will be equipped for electric motor drive, power for which will be furnished by two 135-hp gas-engine units. It is understood that contracts for machinery have already been placed.

COLUMBUS, OHIO.—Contracts have been awarded for equipment for the Spring Street power plant of the Columbus Railway & Light Company as follows: The Jeffrey Manufacturing Company, of Columbus, Ohio, for structural steel work for the new plant and for coal and ash handling machinery; the Allis-Chalmers Company, of Milwaukee, Wis., for turbo-generators with a rating of 4000 kw; condensers to the Worthington Pump Company, of New York, N. Y.; for boilers, to the Babcock & Wilcox Company, New York, N. Y.; the Green Fuel Economizer, of Chicago, Ill., for inducted draught fan apparatus and automatic stokers. The cost of the addition to the plant is estimated at about $200,000. It is expected to have the plant completed by August 1.

MARTINS FERRY, OHIO.—The City Council has voted to issue bonds to the amount of $18,000, the proceeds to be used for improvements to the municipal electric light plant.

NORWOOD, OHIO.—The City of Norwood will receive bids for $18,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant. L. H. Gebhart is city auditor.

TOLEDO, OHIO.—The capital stock of the Toledo & Indiana Traction Company has been increased from $10,000 to $400,000. Preliminary steps have been taken by the new owners for reorganizing the company.

TOLEDO, OHIO.—The Toledo Railway & Light Company has awarded a contract to the Toledo-Massillon Bridge Company for a large coal crane and crusher to be installed in connection with its power plant on Water Street.

ALTUS, OKLA.—The City Council has engaged the J. W. Maxcy Engineering & Construction Company to take charge of the work in connection with improvements to the water and sewer systems and electric light and power plant, calling for an expenditure of $135,000. The extensions to the electric plant will cost about $35,000.

MEDFORD, OKLA.—Bids will be received until April 13 for furnishing material and equipment for construction of the municipal electric light plant, for which bonds to the amount of $18,000 have been voted. O'Bannon & Foster Company, of Joplin, Mo., are consulting engineers.

POTEAU, OKLA.—Plans have been prepared by H. R. Nichol, engineer, of Muskogee, Okla., for an electric light, water works and ice plant for the Poteau Electric Light & Ice Company. The cost of the work is estimated at $15,000.

STILLWATER, OKLA.—The City Council has granted a franchise to L. J. Lampke to construct and operate an electric railway over certain streets in Stillwater. The proposed railway will extend from Stillwater via Yale and Morrison to Perkins. It is said that New York capitalists are interested in the project.

HILLSBORO, ORE.—Application has been made to the Council by E. H. Corbett, of Portland, Ore., for a franchise to construct and operate an electric light plant in Hillsboro. If granted a franchise it is proposed to install a complete new plant.

MARSHFIELD, ORE.—The Coos Bay Rapid Transit Company has applied for a charter to construct an electric railway which will connect the towns on Coos Bay, including Marshfield, Empire and North Bend. The company will be capitalized at $1,000,000 and the incorporators are: L. D. Kinney, George M. Everett and George W. Kitchen.

PORTLAND, ORE.—Application has been made by the Fairdale, Trask & Tillamook Railway Company for a charter, with a capital stock of $10,000. The company proposes to construct an electric railway from Fairdale to Tillamook. The main office is in Portland, Ore. R. Haskins, A. B. Wastell and J. H. Gearin are interested in the project.

ALTOONA, PA.—The City Council has awarded the Penn Central Light & Power Company a contract for street lighting. The contract is for a period of 10 years, beginning April 4, under the terms of which the company is to replace the present lamps with metallic flame arc lamps, of which at least 125 must be installed within six months.

CAMBRIDGE SPRINGS, PA.—The Borough Council is reported to have awarded the Erie Company, of Erie, Pa., a contract for the installation of an electric light plant.

EASTON, PA.—The power plant, which is being erected in connection with the new Alsens mills of the Alpha Portland Cement Company, will be equipped with three tandem gas engines direct connected to three 500-kw, alternating-current generators; also a vertical gas engine driving an air compressor, contracts for which have been closed. Gas will be furnished by producers. The factory will be equipped for electric motor drive throughout. It is understood that a large line of electrical equipment will be required.

PALMYRA, PA.—The Palmyra Electric Light & Power Company, recently incorporated, at Lebanon, Pa., it is said, will install an electric plant in Palmyra during the coming summer.

PHILADELPHIA, PA.—Plans are being prepared by the Quaker City Chocolate & Confection Company for the construction of a four-story addition to its factory. The company, it is said, will be in the market for equipment for the addition, which will include two boilers, a direct-connected generator and engine, two 7500-gal. pressure tanks, elevators, etc.

YORKVILLE, S. C.—The York Cotton Mills, it is said, is planning to increase its capital stock from $150,000 to $300,000, the proceeds to be used for the installation of additional machinery. Electricity will be used to operate the new machinery. J. G. Wardlaw is president of the company.

GETTYSBURG, S. D.—At an election to be held April 19 the proposition to establish a municipal electric light plant and water works will be submitted to a vote.

MITCHELL, S. D.—The Missouri Valley Engineering Company, of Mitchell, S. D., is interested in a hydroelectric power project in the Black Hills. R. M. Fulweiler is chief engineer of the company.

RAPID CITY, S. D.—The Dakota Power Company is reported to have engaged the Missouri Valley Engineering Company, of Mitchell, S. D., to prepare plans for the construction of its proposed hydroelectric power plant. About 5000 kw will be developed. Electricity generated at the plant will be utilized, chiefly at the mines and reduction plants in the Black Hills.

SIOUX FALLS, S. D.—It is understood that John Morrell & Company will soon purchase machinery for their new packing plant to be erected in Sioux Falls. A steam-driven electric plant, with an output of about 750 hp, will be installed, the equipment of which will include boilers, engines, generator, exciter switchboard, motors, etc.

TYNDALL, S. D.—Sealed proposals will be received by J. J. Maus, city auditor, Tyndall, S. D., until April 14 for construction of an electric light plant and improvements to the present water-works system. The work will consist of the following: 1—Brick building, 42 ft. x 86 ft. 2—Gas-producer plant, consisting of two units of 65 hp and 85 hp, respectively, or crude-oil engines. 3—Electric installation, consisting of two units of 40 kw and 55 kw. 4—Pole line and wiring. 5—1900 ft. 8-in. pipe line. 6—Power pump having a capacity of 350 gals. per minute and 25-hp motor. Each of the above to be installed complete and to include all auxiliaries. Plans and specifications may be seen at the office of the city auditor, Tyndall, S. D., and at the office of Oscar Claussen, St. Paul, Minn., consulting engineer.

GALLATIN, TENN.—The Gallatin & Suburban Railway Company has filed amendments to its charter changing its name to the Grand Belt Interurban Railway Company. C. H. Fidler, of Gallatin, is interested in the project.

JOHNSON CITY, TENN.—Arrangements are being made by the Johnson City Traction Company to extend its railway to the Carter addition, work on which will begin in the near future. It is reported that rights of

way are being secured for an electric railway from Johnson City to Elizabethton, via Milligan College.

MEMPHIS, TENN.—The Tennessee Traction Company has secured most of the right of way and surveys are now being made for its proposed electric railway from Memphis to Jackson and Nashville, a distance of 210 miles. George E. Bushnell, of Memphis, Tenn., is general manager.

MEMPHIS, TENN.—Arrangements are being made by the Memphis Telephone Company for extending its telephone lines into Arkansas. The cost of the proposed extension is estimated at $50,000. The extension depends on the passage of a bill in Congress granting the company the privilege to cross the Mississippi River with telephone lines. The company will soon commence work on the construction of a new substation at Diana Street and Monroe Avenue.

NASHVILLE, TENN.—The Nashville Railway & Light Company has applied for a franchise to double track its line on West End Avenue, in Nashville, and to construct an extension to Salem and Bosley.

OBION, TENN.—At an election held March 20 the citizens voted to issue $30,000 in bonds, the proceeds of $15,000 to be used for extensions and improvements to the municipal electric light plant.

SPARTA, TENN.—The Anderson-Tubb Power Company has resumed work on construction of its plant located below the town. The company proposes to supply electricity in Sparta for lamps and motors and will also furnish a day service. The cost of the plant is estimated at $50,000.

AUSTIN, TEX.—Application has been made to the City Council by John Andreawatha, of Austin, Tex., for a franchise to construct and operate a gasoline or electric motor car system over the principal streets in this city.

AUSTIN, TEX.—The Austin Electric Railway Company has applied for a franchise to cross the new concrete bridge crossing the Colorado River, connecting the city with the suburb of South Austin. If granted a franchise the company will extend its railway into South Austin, covering the principal streets of that suburb.

AUSTIN, TEX.—The Austin Dam & Suburban Railway Company, which formerly operated several miles of electric railway in Austin and a line extending to the site of the great dam and pleasure resort on the Colorado River, three miles west of the city, which were destroyed several years ago by a flood, is rebuilding the railway to the dam in order to be prepared to handle material for construction of the new dam at that place, contract for which was recently awarded.

BAY CITY, TEX.—The City Council has awarded a contract to the Crystal Ice & Light Company, of Bay City, Tex., for street lighting, under the terms of which the company is to furnish 50 incandescent street lamps of 32 cp. The company is installing new machinery in its plant.

CROCKETT, TEX.—It is reported that the Lobo Land & Irrigation Company will require a large engine or motor-driven pumps during the coming year in connection with its extensive irrigation project.

ELDORADO, TEX.—Preparations are being made by the Eldorado Water & Power Company for the installation of an electric-generating unit and other equipment.

HOUSTON, TEX.—Preparations are being made by the Penn City Terminal Company, of Houston, Tex., to construct an interurban railway from this city to Penn City. The proposed railway will be about 10 miles in length and will be operated either by electricity or gasoline motors. Judge John G. Todd, of Houston, Tex., is attorney.

PALESTINE, TEX.—George W. Burkitt, Sr., president of the Palestine Electric & Ice Company, is interested in a project to construct a street railway system in Palestine. It is proposed to form a company by local business men to establish the system. Application will be made to the City Council for a franchise covering the principal streets of the city.

EPHRAIM, UTAH.—The Gunnison Valley Power Company, recently incorporated, has completed plans for the construction of its plant and transmission lines, which it is expected to have completed by August 1. The plant is to be located on Six Mile Creek, and will develop about 400 hp. The company will furnish electricity for lamps, heat and motors throughout Sanpete County. M. Beaureguard is president of the company.

MANTI, UTAH.—The construction of a municipal electric light plant and water works system in Manti is under consideration. An election will soon be held to vote on the proposition to issue $40,000 in bonds, the proceeds of $15,000 to be used for the electric plant and the remainder for water works system.

MURRAY, UTAH.—A movement is under way to have the municipalities of Murray, Midvale and Sandy own and operate their respective electric light and power plants. It is proposed that the three towns unite and construct and operate a large plant jointly to serve the three places.

OGDEN, UTAH.—The Ogden Rapid Transit Company is installing a 300-kw, 550-volt, Allis-Chalmers generator in its plant. Extensions will be made to the switchboard, which will be furnished by the Allis-Chalmers Company.

SALT LAKE CITY, UTAH.—It is reported that the Ely Centennial Mining Company is installing a complete electric light plant in connection with its works.

FAIR HAVEN, VT.—The Rutland Railway, Light & Power Company has applied for a franchise to extend its electric railway through Fair Haven and over the Evergreen road to Poultney.

COVINGTON, VA.—The Delford Company, proprietors of the large tannery in Covington, has awarded a contract for an electric light plant for the purpose of lighting its tannery by electricity.

ABERDEEN, WASH.—The Aberdeen Lumber Company, which is equipping part of its mill for electric motor drive, has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for one 115-kw, 480-volt, three-phase, 60-cycle, 900-r.p.m., belted generator; one 6½-kw, 120-volt exciter; two 50-hp, squirrel-cage induction motors and switchboard.

BELLINGHAM, WASH.—It is reported that interests affiliated with the Superior Portland Cement Company are contemplating the construction of a hydroelectric power plant on the Baker River, near Bellingham, which will ultimately develop 25,000 hp. It is understood that turbines with alternating-current generators will be installed in the power station. The purchase of machinery will not be considered for the present.

CHENEY, WASH.—The Washington Southern Telephone Company has applied to the City Council for a franchise to construct and operate a telephone system in Cheney. The company offers long-distance connection with Portland and points in Idaho and Montana.

ORIENT, WASH.—We are informed that J. L. Leeper, of Orient, and associates propose to organize and incorporate an irrigation and electric light company, with a capital stock of $300,000. Mr. Leeper and associates recently filed a notice of appropriation of water rights on Kettle River, to be utilized to generate electricity and for irrigation purposes.

REPUBLIC, WASH.—The North Washington Power Company is reported to be planning to extend its transmission lines into the Republic Camp for the purpose of furnishing electrical service to the mines; also to furnish electricity for public and domestic purposes.

SEATTLE, WASH.—The Superior Portland Cement Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for additional electrical equipment for its plant, including a 250-kw, three-phase, 60-cycle, 600-volt, 600 r.p.m., belt-driven alternator and a 9-kw, 120-volt exciter for same.

SEATTLE, WASH.—Plans are being prepared by Schwager-Nettleton, Inc., for the construction of a large saw mill, which will be equipped for electrical operation. The equipment of the power plant will consist of a 750-kw steam turbo-generator set. Alternating current will be used to operate the machinery.

SEATTLE, WASH.—Application has been made to the City Council by C. J. Smith, H. C. Henry and others for a 50-year franchise to construct and operate an electric and steam heating plant in the district between Yesler Way and Galler Street, Broadway and the water front, except in the district now served by the Seattle Electric Company.

SPOKANE, WASH.—Plans are being considered by the Washington Water Power Company to develop 40,000 hp at Spokane Falls, on the Spokane River, at a cost of about $1,000,000. Two plans are under consideration, one of them calling for the sinking of a shaft from the crest of the upper falls to the bed rock in the river, a depth of 135 ft., and connecting with a tunnel to the Post Street plant. The second plan is to construct a pipe line from the upper falls to the converting plant and erect a dam at the beginning of the falls. David L. Huntington is president of the company.

TACOMA, WASH.—The North Coast Mining & Smelting Company is negotiating for the construction of an electric railway, 180 miles in length. Water rights sufficient to develop 200,000 hp have been secured. For further information address W. W. Shenk, Little Building, Lincoln, Neb.

WENATCHEE, WASH.—It is reported that the Brown Electric Company will open bids early in April for the construction of a hydroelectric power plant on the Entait River, to cost about $500,000. It is proposed to construct a dam 480 ft. long and 55 ft. high, a concrete pipe one-half mile long and 10 ft. in diameter, and a concrete power house. About 5000 hp will be developed.

BLUEFIELD, W. VA.—The Bluestone Traction Company has applied for a franchise for a new electric railway between Graham, Va., and Bluefield, W. Va.

HUNTINGTON, W. VA.—Orders have been placed by the American Car & Foundry Company with the Allis-Chalmers Company for additional power equipment for its plant in Huntington, W. Va., which will include an 18-in. x 24-in., single-tandem gas engine, direct connected to a 250-kw, 240-250-volt, direct-current generator. The engines will operate on natural gas.

THACKER, W. VA.—The Thacker Coal & Coke Company has placed an order with the Allis-Chalmers Company, of Milkaukee, Wis., for a 200-kw, 500-volt, 200-r.p.m., direct-connected generator and a switchboard.

ALLOUEZ, WIS.—The Great Northern Railroad Company has awarded the contract for construction of new buildings, including a power house, in connection with its large terminal project at Allouez, to Schmidt Brothers & Hill, of Superior. The cost of the entire work is estimated at about $250,000.

APPLETON, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 12, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office, Appleton, Wis., in accordance with plans and specifications, copies of which may be obtained from the custodian of the site at Appleton, or at the above office. James Knox Taylor is supervising architect.

BENTON, WIS.—Plans are being considered by the Frontier Mining Company for the construction of a power plant and installation of machinery for concentrating ore.

CHIPPEWA FALLS, WIS.—The plant and holdings of the Chippewa Falls Water Works & Lighting Company have been purchased by capitalists interested in the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis. The property includes water works, electric light plant and gas plant in Chippewa Falls.

DELAVAN, WIS.—The plant and holdings of the Delavan Light & Power Company were sold recently at public auction to George M. Cantwell, for $18,000.

ELKHORN, WIS.—Bids will be received by Grant D. Harrington, county clerk, Elkhorn, Wis., until April 14, for furnishing material and construction of power house, heating and lighting and ventilating system at the Walworth County Poor Farm and Insane Asylum, in accordance with plans and specifications prepared by Claude & Stark, architects, of Madison, Wis., which are on file at the office of the county clerk, Elkhorn, Wis.; at the office of the architects, Madison, Wis.; Ralph Chatham, 530 South Clinton Street, Chicago, Ill., and the Builders' and Traders' Exchange, Milwaukee, Wis.

GREEN BAY, WIS.—The contract for electric fixtures for court house has been awarded to the Morrean Gas Fixture Company, of Cleveland, Ohio, for $3,000.

LA CROSSE, WIS.—Plans have been completed by the La Crosse Water Power Company for the construction of the new East Fork dam, north of Hatfield, Wis. The dam is to be 33 ft. high and 350 ft. long.

MAUSTON, WIS.—The Mauston Electric Service Company is reported to have purchased the mill property and water rights at New Lisbon. The company, it is said, will make extensive improvements to the property.

STOUGHTON, WIS.—The City Council has granted the Cincinnati Construction Company an extension of six months to its franchise in Stoughton, which has just expired. The company proposes to construct an interurban railway between Stoughton and Madison. It is said that the company will begin work on the proposed road May 1. Joseph Ellis, of Madison, Wis., is engineer.

WAUKESHA, WIS.—The Waukesha Lime & Cement Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for its plant, which includes one Gates breaker, two Gates elevators and four three-phase, 60-cycle, 400-volt, squirrel cage, induction motors varying in size from 30 hp to 150 hp.

WAUTOMA, WIS.—The farmers and citizens of Wautoma have decided to organize a new telephone company and erect rural telephone lines surrounding Wautoma. The company will be capitalized at $10,000.

SHOSHONI, WYO.—A local company has been organized to supply electrical service in Shoshoni. Electricity for operating the system will be obtained from the power plant of the Big Horn Company, located in the Big Horn Canyon, at Boysen.

CALGARY, ALTA., CAN.—An estimate has been prepared by Commissioner Graves for extensions and improvements to the municipal electric light plant, which calls for an expenditure of about $70,000 and includes 86,074 lb. of weatherproof wire, at $15,593; 550 poles, at $2,169; 2600 crossarms, at $920; rubber-covered wire, porcelain tubes, lamp sockets, sundries, etc., at $5,621; meters, various sizes, $12,000; transformers, various sizes, $10,280; 100 arc lamps and station transformers and equipment, $7,000.

CALGARY, ALTA., CAN.—Plans have been completed by J. T. Childs, city engineer, for the proposed municipal electric light and power plant, costing $125,000. The commissioners have decided to recommend to the City Council that a by-law covering this amount be submitted to the ratepayers. It is proposed to secure authority to go ahead with construction of the power house in case negotiations with the Calgary Power Company fall through. The proposed plant will have an output of 2000 hp and provision will be made to increase it to 4000 hp when needed.

CAMROSE, ALTA., CAN.—It is reported that plans are being prepared for the installation of a municipal electric light and power plant in Camrose during the coming summer.

PRINCE RUPERT, B. C., CAN.—Bids will be received by Thomas Dunn, chairman electric light commission, until May 3 for boilers, engines, condenser pumps and piping, together with electrical apparatus.

VICTORIA, B. C., CAN.—Notice has been given by the West Coast Power Company of its intention to develop the water power of the Gordon River, below Big Cawpon, where it is estimated that 110,000 hp can be developed. Lorenzo Alexander is a director of the company.

BELLEVILLE, ONT., CAN.—James G. Lindsay, city engineer, has recommended to the City Council the installation of two turbine pumps and two 85-hp motors at the water works, the cost of which is estimated at $5,000.

STIRLING, ONT., CAN.—The by-law to appropriate $10,000 for electric lighting was carried at an election held recently.

STRATFORD, ONT., CAN.—The ratepayers on April 14 will vote on the by-law to provide $85,000 for the construction of a distributing plant for Niagara power.

TORONTO, ONT., CAN.—The Toronto & York Radial Railway Company is contemplating extending its Scarboro division to Markham. W. H. Moore, of Toronto, is general manager.

GUADALAJARA, JALISCO, MEX.—Arrangements are being made by the Guadalajara Light & Power Company to begin work on its proposed electric railway, which is to extend from Guadalajara to Chapala, a distance of 34 miles. The right of way for the entire distance of the proposed road has been donated.

NUEVO LAREDO, MEX.—Arrangements are being made to construct an electric railway in Nuevo Laredo. The proposed railway will extend from the tramway bridge to the custom house. Later it is planned to extend it to the machine shops of the National Railways Lines of Mexico.

New Industrial Companies.

THE AMERICAN ARCH COMPANY, of New York, N. Y., has been chartered with a capital stock of $700,000 to manufacture and deal in railway supplies and equipment. The incorporators are: J. Pettit, C. G. Hawley, of Chicago, Ill., and J. S. Coffin, of New York, N. Y.

THE AMERICAN ELECTRIC PROTECTIVE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and sell electric fire alarm systems. The incorporators are: B. Webb, of the Bronx, N. Y.; M. Schlansky and H. A. Goldner, of New York, N. Y.

THE AMERICAN TAXIMETER COMPANY, of New York, N. Y., has been chartered, with a capital stock of $200,000, by V. C. King, J. A. Straussman, of New York, N. Y., and A. A. Meschutt, of Ridgewood, N. J. The company proposes to manufacture and deal in materials for electrical engineers, tool makers, metal workers, etc.

THE J. ELWOOD BAIRD COMPANY, of Buffalo, N. Y., has been chartered, with a capital stock of $5,000, for the purpose of doing a general contracting business. The incorporators are: J. Elwood Baird, E. H. Baird and Andrew D. Farrell, all of Buffalo, N. Y.

THE BISHOP-TAVERNICK COMPANY, of Rochester, N. Y., has been incorporated, with a capital stock of $8,000, for the purpose of doing a general contracting business. The incorporators are: Edwin P. Bishop, L. H. Bishop and Herman Tavernick, all of Rochester, N. Y.

THE CANNON CONSTRUCTION COMPANY, of New York, N. Y., has been chartered with a capital stock of $5,000 by William F. Cannon, Brooklyn, N. Y., and James J. McGuire, of New York, N. Y. The company proposes to do a general construction and contracting business.

COFFIN & ZEIFANG, of Niagara Falls, N. Y., has been incorporated, with a capital stock of $2,500, by George M. D. Heard, John Coffin and John F. Zeifang, all of Niagara Falls, N. Y. The company proposes to manufacture machinery and do a general manufacturing business.

THE EAGLE COMPANY, of Newark, N. J., has been chartered with a capital stock of $1,500,000 by J. F. Alvord, B. S. Keefer, F. P. Weston, of Torrington, Conn.; J. R. Viles, of New York, N. Y., and G. Badenoch, of Newark, N. J. The company proposes to manufacture machines, sweepers, cleaning machines, etc.

THE ELECTRICITY SAVING COMPANY, of New York, N. Y., has been incorporated by Adolph Hess, Edward M. Kaston and Victor Bernhard, of New York, N. Y. The company is capitalized at $15,000, and proposes to manufacture electrical devices, etc., and to install illuminating and power systems.

THE ELECTROLYTIC PRODUCTS COMPANY, of Buffalo, N. Y., has been incorporated, with a capital stock of $100,000, by H. C. Steul, F. A. Abbott and J. Porzel, of Buffalo, N. Y. The company proposes to manufacture and sell radiators for automobiles, etc.

THE HAMILTON SIGN COMPANY, of New York, N. Y., has been incorporated by Hamilton G. Jacobs, of New York, N. Y.; Henry Feld, of New York, N. Y., and Samuel Autor, of Brooklyn, N. Y. The Company is capitalized at $15,000 and proposes to manufacture and deal in electrical signs, billboards, etc.

THE HAMLER-EDDY SMOKE RECORDER COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $100,000, by E. W. Fottel, R. Goepfert and G. J. Meier, of Chicago, Ill. The company proposes to manufacture machinery.

HARPER, JAVA AND KEHOE, INC., of Newburgh, N. Y., has filed articles of incorporation with a capital stock of $10,000 by Abner M. Harper, John A. Java and James L. Kehoe, all of Newburgh, N. Y. The company proposes to build railways, bridges, etc., and do a general contracting business.

THE HARRIS MACHINERY COMPANY, of Durham, N. C., has been chartered with a capital stock of $25,000 by C. W. Byrd, J. T. Broadway and others. The company proposes to do a general electrical and mechanical engineering business and to manufacture all kinds of tools and machinery.

THE HOLOPHANE COMPANY, of New York, N. Y., has been chartered, with a capital stock of $1,500,000, for the purpose of dealing in illuminating appliances, etc. The directors are: Otis A. Mygatt, Van Rensselaer Lansingh and Robert Kelly, Jr., of New York, N. Y.

THE HYDROLITH COMPANY OF NEW YORK, of Brooklyn, N. Y., has been chartered with a capital stock of $20,000 by Andrew Neilsen, James R. Dowle and John Flint, all of Brooklyn, N. Y. The company proposes to do a general contracting and construction business.

THE INTERNATIONAL TELEPHONE COMPANY, of Columbus, Ohio, has been chartered, with a capital stock of $300,000, by E. C. Woodworth, John C. Hewett, E. E. Learned, Katherine E. Learned and E. W. Brinker. The company proposes to make a specialty of manufacturing the Hasting-Matheny lockout device.

THE INTERURBAN CONSTRUCTION COMPANY, of Chicago, Ill., has been chartered with a capital stock of $60,000 to construct interurban railways.

THE JUNIATA VALLEY CONSTRUCTION COMPANY, of Camden, N. J., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of constructing electric, steam and gasoline electric railroads. The incorporators are: A. J. Starr, H. E. Steel, G. W. Eisner, B. F. Godard, of Huntington, Pa., and H. E. Traux, of Camden, N. J.

THE LAMMA MANUFACTURING COMPANY, of Greenwich, Conn., has filed a certificate of incorporation, with a capital stock of $10,000, for the purpose of manufacturing friction braid or tape for insulating purposes. The incorporators are: J. S. Keith, of New York, N. Y.; G. H. Rees, of Brooklyn, N. Y., and Janes Guarglia, of Hoboken, N. J.

THE LIGHT MACHINE COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing and dealing in engines, boilers, tools, gas and electric fixtures, etc. The incorporators are: S. Ergang, S. Polster, A. J. Rosemarin, of New York, N. Y.

I. M. LUDINGTON'S SONS, INC., of Rochester, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of doing a general contracting business; to build public works of all kinds, bridges, roads, docks, etc. The incorporators are: C. Ludington, I. W. Ludington and M. R. Ludington, all of Rochester, N. Y.

THE MASSACHUSETTS EXPERIMENTAL & CONSTRUCTION COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $30,000, for the purpose of handling patents and patents rights. A. O. Vestine, of Dorchester, Mass., is president, and A. I. Bacigalupo, of Medford, Mass., treasurer.

THE ROULLIER ENGINEERING COMPANY, of Flushing, N. Y., has been incorporated with a capital stock of $10,000 to conduct a general civil engineering and surveying business by Gustave A. Roullier, of New York, N. Y.; Albert H. Kimball and S. M. Roe, both of Flushing, N. Y.

THE SAFETY ELECTRIC COMPANY, of Newark, N. J., has been incorporated by C. P. Taylor, C. H. Fay and Scott German, all of Newark, N. J. The company is capitalized at $125,000 and proposes to manufacture electric motors, dynamos and other electrical machinery.

THE SOWERS MANUFACTURING COMPANY, of Buffalo, N. Y., has been incorporated by Franklin D. L. Stowe and B. O. Kerr, of Buffalo, N. Y. The company is capitalized at $100,000, and proposes to manufacture and sell machinery, engines, boilers, etc.

THE STRUCTURE COMPANY, of New York, N. Y., has been chartered with a capital stock of $15,000 to do a general engineering, building and contracting business. The incorporators are: William H. Smith, Charles R. Campbell and Edward Van Antwerp, all of New York, N. Y.

THE SUBWAY TELEPHONE CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $100,000, by J. Harris, S. F. Harris and A. E. Wilson. The company proposes to construct and operate telephone and telegraph lines.

THE WINANS MACHINE COMPANY, of Binghamton, N. Y., has been chartered by T. J. Winans, D. M. Winans and C. J. Knapp, of Binghamton, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in machinery, tools, etc.

New Incorporations.

CORNING, ARK.—Articles of incorporation have been filed for the Southern Ice & Power Company, with a capital stock of $10,000. The officers are: A. Booser, president; W. D. Polk, vice-president, and W. W. Henry, secretary and treasurer.

HELENA, ARK.—The West Helena Company has been incorporated with a capital stock of $100,000 for the purpose of constructing a water, light and heating plant. E. C. Horner is president, and John E. Horner secretary and treasurer.

SPRINGFIELD, GA.—The Effingham Telephone Company has been chartered with a capital stock of $5,000 by C. F. Berry, J. B. Simmons, of Springfield, Ga., and others.

HARVEY, ILL.—The Eastern Illinois Railway Company has been incorporated with a capital stock of $1,000,000 to construct and operate a railway from West Hammond to Harvey, Ill. The incorporators are: W. E. Snyder, W. H. Robinson and J. Cox, all of Chicago, Ill.

WAYNETOWN, IND.—The Waynetown Electric Light Company has been incorporated with a capital stock of $10,000 to build and operate an electric plant to furnish electricity for lamps and motors in Waynetown and adjacent towns. The directors are: Thomas Lewellen, W. L. Smith, of Waynetown, and Samuel C. Rowland, of Crawfordsville, Ind.

CHARLES CITY, IA.—The Charles City & Western Railway Company has been incorporated with a capital stock of $300,000 to construct and operate an electric urban and interurban railway, 40 miles in length, in Charles City and extending into the surrounding country. C. W. Hart, of Charles City, Ia., is president of the company.

ELLIOTT, IA.—The Elliott Mutual Telephone Company has filed articles of incorporation with a capital stock of $20,000. The incorporators are: H. E. Leonard, O. J. Powell, M. M. Roberts, M. S. Ling, J. N. Holtmyer, J. H. Pelty and W. L. DeWitt.

MINNEAPOLIS, MINN.—The Minneapolis & St. Paul Suburban Railway Company has been chartered with a capital stock of $1,000,000 to operate an electric railway between the business centers of Minneapolis and St. Paul, Minn., in which is included the system of the Twin City Rapid Transit Company. The officers are: C. G. Goodrich, of Minneapolis, Minn., president; W. J. Hield, vice-president and general manager, and S. E. Pattee, secretary and treasurer.

NEW EGYPT, N. J.—The New Egypt Light, Heat, Power & Water Company has been chartered with a capital stock of $30,000 to operate light, heat, power and water plants. The incorporators are: G. L. Shinn, W. C. Jones and W. Chambers, of New Egypt, N. J.

HAMILTON, N. Y.—The Hamilton Telephone Company has been incorporated with a capital stock of $10,000 by Herbert H. Hawkins, of Hamilton, N. Y; W. S. Hawkins, of Waterville, N. Y., and Charles B. Sanford, Hamilton, N. Y.

GOODRICH, N. D.—Articles of incorporation have been filed for the Goodrich Telephone & Electrical Company. The company is capitalized at $10,000, and the incorporators are: C. E. McReynolds, Emil M. Jassamann and John M. Jassaman, all of Goodrich.

EMMETSBURG, PA.—Articles of incorporation have been filed for the Postville Light & Heating Company by Noble Wilcox, B. N. Allen and T. C. Murray. The company is capitalized at $25,000.

PALMYRA, PA.—The Palmyra Electric Light & Power Company has been granted a charter with a capital stock of $20,000. Daniel Weaver is treasurer.

CLARKSVILLE, TENN.—Articles of incorporation have been filed for the Clarksville Home Telephone Company, with a capital stock of $75,000, by R. B. Crane, W. G. Nagle, of Toledo, Ohio; D. Fort, H. C. Merritt and L. E. Ladd, of Clarksville, Tenn.

FRANKLIN, TEX.—The Franklin Telephone Exchange has been incorporated with a capital stock of $5,000 by R. W. Cole, F. S. Estes, R. M. Cole and J. L. Goodman.

MARFA, TEX.—The Presidio County Telephone Company has been incorporated with a capital stock of $6,000 by W. H. Cleveland, A. M. Porter, T. C. Mitchell and others.

ILWACO, WASH.—The North Shore Light & Power Company has been chartered with a capital stock of $25,000 by F. M. Eidson, E. L. Hutchin and C. E. Houston.

PORT TOWNSEND, WASH.—The Key City Light & Power Company has been chartered with a capital stock of $80,000 by John Sillenbaum, Peter Mutty, N. D. Hill, J. M. Kincaid and S. McGee.

WASHINGTON, WIS.—The Washington Inland Telephone Company has been incorporated with a capital stock of $3,000 by William Jess, John Gislason, G. O. Mann, M. Foss and B. Johnson.

Legal.

DESCHUTES IRRIGATION & POWER COMPANY IN RECEIVER'S HANDS.—C. E. Redfield has been appointed receiver of the Deschutes Irrigation & Power Company by Judge R. S. Bean, of the Federal Court. Mr. Redfield, who is engineer of the company, was agreed to as receiver by both sides of the controversy. Action in the case was instituted by the Ohio bondholders, who claim that the company has been mismanaged.

FAILURE TO MAINTAIN GUARD WIRES.—A number of cases have arisen in the courts recently wherein the claim for damages has been based on the negligence of the defendant in not taking proper care of its wires. A telephone wire, broken by a sleet and rainstorm of unusual severity, hung down upon an electric lighting wire and became charged with electricity. A sixteen-year-old boy came in contact with the wire and was killed. It was claimed by the plaintiff that the company was negligent in failing to have a protection of some kind between its wires and the wires of the electric lighting company immediately underneath, so that if a wire of the defendant company broke or became disengaged it would be prevented from coming into contact with the wires of the lighting company, thereby avoiding the danger which caused the death of the plaintiff's son. The plaintiff called three witnesses, all of whom testified that they had known of guards between telephone and telegraph wires and wires of high tension, at crossings, which would prevent the former when they broke from coming in contact with the latter. Not one of these witnesses testified that such a contrivance was in use any place where, as here, electric lighting wires ran along the street, underneath those of the telephone or telegraph company, nor that under such circumstances, if one had been used, it would have prevented the wires from coming in contact with each other in case of a break. The court was, therefore, of the opinion that the plaintiff had not made out a case and judgment was given for the defendant. Stark vs. Pennsylvania Telephone Company. 74, Atl. Rep. 222.

Personal.

MR. J. A. MYLER has resigned his position as manager of the Union Gas & Electric Company, of Bloomington, Ill.

PROF. R. A. FESSENDEN is now in Europe in connection with his systems of wireless telegraphy and telephony.

PROF. DR. W. JAEGER, of the Physikalisch Reichsanstalt, Berlin, is temporarily at Washington in connection with work relating to international standards.

MR. GUY P. FELTON, of Blakely, Ga., has been appointed superintendent and engineer of the electric light and waterworks plant of Cuthbert, Ga.

MR. FREDERIC LAPORTE, assistant director of the Laboratories Central d'Electricite, Paris, is on a visit to this country where he will remain about two months.

MR. C. A. COPELAND, formerly assistant electrical engineer of the Pacific Electric Railway Company, Los Angeles, has become associated with the department of operation and maintenance of the Pacific Gas & Electric Company, San Francisco.

MR. F. E. SMITH, of the National Physical Laboratory, London, is on a visit to this country in connection with work relating to international standards in the Bureau of Standards, Washington.

MR. C. D. ARMSTRONG, who was formerly with the Montgomery (Ala.) Light & Water Power Company, has been appointed manager of the commercial department of the New Orleans Railway & Light Company.

MR. E. F. SCATTERGOOD, chief electrical engineer of the Los Angeles Aqueduct, presented a paper entitled "Electric Power in the Construction of the Aqueduct" before the Los Angeles Section of the American Institute of Electrical Engineers on March 22.

MR. R. C. RICHARDS, who for many years served as claim agent for the Chicago & Northwestern Railroad Company, has been appointed accident inspector for the road. He will investigate the causes for accidents and decide upon devices and methods for their elimination.

MR. JOHN J. SCHAYER, manager of the Electric Shop, Chicago, has again been appointed assistant master of transportation for the National Electric Light Association, to have charge of the arrangements for a special train to accommodate those in Chicago and vicinity who desire to attend the convention of the association in St. Louis, May 23 to 28.

MR. C. T. ALDEN has become interested in J. B. Taylor & Company, Engineers, 37 Liberty St., New York, and on April 1 became chief engineer and general manager of the firm. Mr. Alden will reorganize the business and enlarge it, making it an engineering and operating company, taking up electric and steam railways, gas, water-power, irrigation, and other propositions, reorganizing, building, etc.

MR. FRANK N. ROBERTS, widely known among telegraphers and for many years chief operator in the Chicago district for the Postal Telegraph-Cable Company, has been promoted to be traveling traffic supervisor of the Postal company, with headquarters in New York. Mr. Thomas N. Powers succeeds Mr. Roberts as chief operator in the Chicago district.

MR. FRANK McMURDIE, superintendent of the American Blower Company's Detroit plants since about 1894, has resigned, and after a short pleasure trip will take the general superintendency of the Clarage Foundry & Mfg. Co., of Kalamazoo. Mr. McMurdie was one of the oldest employes of the American Blower Company, having entered its employ in 1883.

MR. F. G. WALDENFELS has been appointed chief electrical inspector for the Chicago Board of Underwriters, succeeding Mr. B. E. Blanchard, who has resigned to accept a position on the editorial staff of *Popular Electricity.* Mr. Waldenfels obtained his technical education at the Armour Institute of Technology, and has been connected with electrical construction work since 1893.

MR. HARRISON G. THOMPSON, formerly with the railway department of the Westinghouse Storage Battery Company, and for a long time associated with the Safety Car Heating & Lighting Company, has joined the sales organization of the United States Light & Heating Company. Mr. Thompson has long been identified with the railway business, both in the car lighting and storage battery fields. He will make his headquarters at the New York office, 30 Church Street.

MR. H. M. VAN GORDER, late of the Sayre Electric Company, has joined the Sales Department of The Toronto Electric Light Company, Limited. Mr. Claude Hoffman, of The Allentown Electric Company, has severed his connection with that concern and is to start as a solicitor for the Toronto company April 1. Mr. Reilly, of the Nernst Lamp Company, has resigned his position as sales manager and will join the sales force of the Toronto Company as district agent.

MR. WILLIAM H. HODGE, formerly managing editor of *Public Service,* and a specialist on publicity work for public utility companies, has been appointed in charge of a publicity department just organized by H. M. Byllesby & Company, of Chicago. Owing to the constantly increasing number of cities and towns in which the firm owns, operates and manages utility properties, such a department was considered desirable, and it will handle both the commercial and educational advertising of the organization.

MR. A. L. ROHRER, electrical superintendent of the General Electric Company's works at Schenectady, N. Y., recently inspected the engineering department of the University of Texas. It was the first visit that Mr. Rohrer had made to the university, and he expressed himself as very agreeably surprised at its high standard of equipment and instruction. He selected three students of the department who will graduate this year to fill positions at the plant of the General Electric Company. These young men are Joe Gill and Murray Gill, of Paris, Texas, and T. A. Hord, of Dallas. Mr. Rohrer said that he had accepted 14 out of a class of 75 at Purdue University at Lafayette, Ind., this year.

MR. LUDWIG A. KEMPER has resigned as manager of the Albert Lea (Minn.) Light & Power Company to join the engineering staff of the Fuel Engineering Company, Chicago. Mr. Kemper has made a notable success of the management of the Albert Lea property for the past few years. He was born in 1877, and, after serving an apprenticeship in machine shop and erection work in Amsterdam, was graduated from Delft University, Holland, in 1899 as mechanical engineer. Two years later the degree of electrical engineer was conferred upon him by the Technical High School of Karlsruhe, Germany. In 1901 he developed a process of manufacturing peat briquettes for a Rotterdam company. In 1902, having come to America, he was employed by the Pullman Company as an engineer in connection with train lighting. In 1903 he designed the steam generating and power plant of the American Hominy Company at Indianapolis. After this he served for some time as assistant electrical engineer of the Baltimore & Ohio Railroad, designing several power plants and supervising their erection. He has been manager of the Albert Lea Light & Power Company since 1905, and during this period the net earnings of the company have been quadrupled.

MR. O. C. ROOS has been appointed by the U. S. War Department as wireless engineer for the Bureau of Insular Affairs in the Philippines. Mr. Roos was recently wireless expert in the Experimental Engineering Department of the National Electric Signaling Company, Brant Rock, Mass., and has made a number of contributions to the literature on wireless telegraphy, including the formulation of a law of the radiation of energy from a linear oscillator, and a circle diagram to show the relation between primary and secondary impedance, and the power obtainable from a transformer of unity power factor.

MR. O. C. ROOS.

Obituary.

PROF. MOSES COBB STEVENS, professor emeritus of the mathematics faculty of Purdue University and one of the well-known mathematicians of the Middle West, died suddenly at Tallapoosa, Ga., March 21, as the result of an attack of heart failure. Professor Stevens, who had reached an advanced age, was relieved from active classroom duties several years ago.

COL. L. C. WEIR.—Col. Levi Candee Weir, chairman of the Board of Managers and the Board of Trustees of the Adams Express Company, died of heart disease at the Plaza Hotel, New York, March 28, after an illness of several months. He was born in New Haven, Conn., 68 years ago. During the Civil War he was a member of the Military Telegraph Corps. At the close of the war he entered the service of the Adams Express Company, and rose through the different grades until he became president in 1894. He is survived by his wife, one son and two daughters. The body was cremated March 30.

Trade Publications.

GAS PRODUCERS, designed for using bituminous coal, are described in a convincing manner in bulletin C of the Gibbs Gas Engine Company, Atlanta, Ga.

CRANES.—In booklet No. 93 of the Northern Engineering Works, Detroit, Mich., devoted to foundry machinery and equipment, are given many views of electric hoists and cranes.

LUBRICATING DEVICES for use with graphite in combination with oil are illustrated, described and listed in a booklet of the Graphoil-Lubricator Sales Company, 90 West Street, New York.

SPARK COILS.—The Osburn Electric Company, Detroit, Mich., has issued a well-illustrated 20-page bulletin, devoted to spark coils, magnetos, storage batteries, ignition specialties, etc. The various devices illustrated are fully described and listed.

ELECTRIC CLOCKS for all services in public or private buildings, industrial or commercial plants, schools, or institutions of any kind, are illustrated and briefly described in catalog No. 32 of the Standard Electric Time Company, Waterbury, Conn.

TRACTIVE FORCE OF LOCOMOTIVES.—The American Locomotive Company, New York, has issued bulletin No. 1002, containing a number of tables showing the draw-bar pulls of locomotives having various diameters of drivers and operated at various speeds.

MOTORS.—Bulletin No. 330 of the Holtzer-Cabot Electric Company, Boston, Mass., deals with single-phase induction motors of the self-starting, squirrel-cage type. Direct-current motors rated at from 0.33 hp to 30.0 hp are described in bulletin No. 314B. Dental lathe motors are shown in circular No. 308AA.

CONNECTION LUGS.—The Delta-Star Electric Company, Chicago, has issued distributing sheets 5 and 6 of its new loose leaf price lists,

covering the various sizes of connection lugs used in central station and switchboard work. The technical section contains considerable data on carrying capacity of conductors, and heating effects on different materials.

SCIENTIFIC INSTRUMENTS.—A complete list of physical and scientific instruments is contained in a 260-page catalog issued by W. & L. E. Gurley, Troy, N. Y. The devices covered include accessories for physical laboratory use, mechanical laboratory apparatus, vacuum pumps, optical apparatus, apparatus for the measurement of induction, electromagnets and accessories, magnetometers, inclinometers, variometers, earth inductors, keys for electrical testing galvanometers, Wheatstone bridges, resistors.

SMALL MOTORS.—The Western Electric Company has issued bulletin No. 5360, which takes up the subject of Hawthorn small power motors. The bulletin describes very completely types of small motors, both alternating and direct current, ranging from 1/6 hp to 1/30 hp., suitable for various purposes, such as buffing and grinding wheels, sewing machines, meat grinders and other household machines which require little power to operate. The direct-current motors are built for operation on 110 and 220 volts at various speeds from 1100 to 3400 r.p.m., and are made with either shunt, series or compound windings. The alternating-current small motors are built for 110 and 220 volts at 60, 45 and 25 cycles, single, two and three-phase, at the several synchronous speeds, in a full line of fractional horse-power ratings ranging up to ¼ hp.

BUSINESS NOTES.

SANBORN ELECTRIC COMPANY.—The corporate name of the Sanborn-Marsh Electric Company, Indianapolis, Ind., has been changed to The Sanborn Electric Company.

OTIS & SQUIRES, of San Francisco, have been appointed agents in California, Arizona and Nevada for the Durant Electric Company, of Chicago, makers of rubber covered iron telephone drop wire.

THE GARWOOD ELECTRIC COMPANY has established a branch office in Chicago, in the Old Colony Building, under the management of Mr. J. W. Eskholme, who had been connected with The C & C Electric Company for a number of years.

HUNT, MIRK & COMPANY, of San Francisco, have sold the Union Lumber Company a 1000-kw. Westinghouse-Parsons turbo-generator set, together with switchboard, exciter and condensers. The equipment will be installed in the company's plant at Fort Brogg.

L. J. WING MANUFACTURING COMPANY.—Mr. L. J. Wing has recently resigned as president of the L. J. Wing Manufacturing Company and Mr. E. D. Fieux has been elected as president to fill the vacancy, with C. E. Cole as vice-president; Mr. H. S. Wheller remains as secretary. Mr. Wing still remains a director and stockholder of the company and will devote considerable time to its interests.

THE JOHN A. STEWART ELECTRIC COMPANY, electrical and steam machinery dealers, has removed its general offices from 5th and Sycamore, the old location for the past 18 years, to new quarters in the First National Bank Building, Cincinnati, Ohio. The company is also erecting a concrete and steel warehouse and shops on the main line of the Pennsylvania Railroad and the Richmond Division of the same road at Red Bank Station, Cincinnati, to provide for the handling, displacing and overhauling of the larger electrical and steam apparatus.

R. B. DAGGETT, who for several years has been Pacific Coast manager of the Electric Storage Battery Company, has, with some of his former associates, formed the firm of R. B. Daggett & Company, which will handle electric vehicles and trucks on the Coast. The headquarters of the firm will be in San Francisco, at 1630 Van Ness Avenue, and branch stations have been located in Oakland, San José, Mayfield and San Rafael. Offices will also be opened later in Seattle and Los Angeles. The firm is handling the Baker electric vehicles and the Walker electric trucks, as well as a line of other specialties, including Elks motor boats and launches, Sangamo motors and Reed electric headlights, the latter of which they manufacture.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May 9-12, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Spring meeting, May 4, 5, 6 and 7, 1910.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, H. C. Donecker, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, C. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Los Angeles, Cal., June 20-24, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting, Lake Rosseau, July 6, 7 and 8, 1910.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Glenwood Springs, Sept. 21, 22 and 23, 1910.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Rochester, N. Y., June 21, 1910.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting, Kansas City, Mo., June 11, 1910.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next annual meeting, Chicago, Nov. 3, 1910.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

Engineering Society of Wisconsin. Secretary, W. G. Kirchoffer, 31 Vroman Building, Madison, Wis.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratsch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Rochester, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C: Davis.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Sioux City, April 20 and 21, 1910.

IOWA ELECTRICAL SHOW, Sioux City, Ia., April 20 to 24, 1910.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March, each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April 21 and 22, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., September, 1910.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich. Next meeting, Port Huron, Mich., August 16, 17 and 18.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson, Ry. & Light Co., Jackson, Miss. Next meeting, Greenville, Miss., June 15, 1910.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, Ohio, June 1, 2 and 3, 1910.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York. Next meeting, St. Louis, Mo., May 23-28, 1910.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June 9, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, C. H. Hodskinson, 89 Lafayette St., Boston, Mass.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

NORTHWESTERN ELECTRICAL SHOW, Minneapolis, Minn. March 26—April 2, 1910. Secretary, C. D. Wilkinson, care Western Electric Co., Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskell, Greenville, Ohio. Next meeting, Cedar Point, Sandusky Bay, Ohio, July 26, 27 and 28, 1910.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, May, 1910.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., May, 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, San Francisco, April 1, 1910.

PACIFIC COAST ELECTRICAL EXHIBITION, San Francisco, Cal., May 21, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

PITTSBURG ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings Fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Next meeting, Madison, Wis., June 28, 1910.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex. Next meeting, Beaumont, Tex., May 12-14, 1910.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Lena M. Owen, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WASHINGTON ELECTRICAL SHOW, October or November, 1910.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., October, 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 29, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

953,018. ALTERNATING CURRENT MOTOR; H. Alexander, Berlin, Germany. App. filed July 21, 1909. Polyphase motor of the commutator type in which the brushes and connections form, with the windings, polyphase circuits.

953,021. ELECTRIC SWITCH; F. E. Case, Schenectady, N. Y. App. filed Jan. 11, 1908. For electric cars and locomotives including a power switch and a manual switch in series. Consolidates the main switch and circuit breaker setting and tripping switch in one structure.

953,028. AUTOMATIC SWITCH MECHANISM; A. C. Griscom, New York, N. Y. App. filed Sept. 26, 1907. A solenoid which short circuits separable contacts of a main motor circuit and is short circuited to open the motor circuit.

953,029. ELECTRIC SMELTING FURNACE; E. A. A. Gronwall, A. R. Lindblad and O. Stalhane, Ludvika, Sweden. App. filed May 1, 1906. Furnace of the transformer type, having an endless groove for the metal. Portions of the groove being arranged parallel and close together and a smelting furnace into which a portion of the groove extends.

953,030. TRANSFORMER FURNACE; E. A. A. Gronwall, A. R. Lindblad and O. Stalhane, Ludvika, Sweden. App. filed March 29, 1907. See 953,029.

953,036. SINGLE-PHASE MOTOR CONTROL; G. H. Hill, Schenectady, N. Y. App. filed Sept. 13, 1907. Compensated series motor which is operated by connecting it as a shunt motor at starting, and when it has started changing the connections so as to operate it as a series motor.

953,041. METHOD OF PRODUCING TAPERS IN METAL; L. S. Lachman, New York, N. Y. App. filed Feb. 8, 1908. Heats the metal by an electric current and pulls it to taper to a point, then cuts off the flow of heating current and controls the rate of pulling and of heating so that at the instant of separation the metal will be of a comparatively low temperature.

953,082. SELECTIVE RINGING SYSTEM FOR PARTY LINE TELEPHONES; F. E. Winslow, Des Moines, Iowa. App. filed May 2, 1908. The selection is accomplished by means of two biased ringers, one for each polarity, rung from each main line and one direct-current ringer operative from each main line, thus affording six different selections.

953,084. DOUBLE THROW MOTOR STARTING SWITCH; S. B. Condit, Jr., Brookline, Mass. App. filed Jan. 21, 1909. A multi-

throw switch with a rotary handle producing reciprocating movements of the contact.

953,102. TELEPHONE TRANSMITTER; P. G. Randall, Malden, Mass. App. filed Dec. 19, 1907. A vibrating diaphragm forms one electrode and a granular resistance is held between the diaphragm and the cooperative electrode, the resistance being subdivided to make a plurality of positive contacts.

953,107. MICRO RECEIVER OR TRANSLATOR; P. Stragiotti, Hurley, Wis. App. filed Aug. 11, 1908. For detecting feeble alternating current. The microphone comprises a differential microphone made up of two separate microphones having three electrodes, one solidly connected with a vibrating plate, the other two turning freely around an axis.

953,109. AUTOMATIC ELECTRIC SIGNAL FOR RAILWAYS; W. Tullock, Denver, Col. App. filed Feb. 16, 1909. Particularly for curves in which lamps are operated as a train approaches the curve.

953,139. TRAINING MECHANISM FOR GUNS, PROJECTORS AND THE LIKE; J. L. Hall, Schenectady, N. Y. App. filed Aug. 2, 1906. A turntable, an electric motor, a controller therefor and gearing between the motor and turntable with connections whereby the gearing may be changed from positive to differential gearing by a movement of the controller.

953,140. ARC LAMP; P. Hanisch, Cologne, and J. Rosemeyer, Cologne-Lindenthal, Germany. App. filed Sept. 14, 1909. Arc lamps with carbons side by side in which the forward feed is produced by a

953,204.—Indicator for Enclosed Fuses.

clamp, dispensing with the electromagnetic control of the clamp, the feeding being effected by burning away a contact carbon which through a lever transmits the feeding movement.

953,188. TELEPHONE SYSTEM; A. H. Weiss, Chicago, Ill. App. filed July 24, 1905. Improvement on a cord circuit system in which a jack with three contacts is used, the cord circuit having tip and sleeve strands terminating in plugs with electrical connections with the jack, a battery, a supervisory signal, a pair of relays controlling the signal, a listening key, the path of current from the battery to the sleeve to the calling plug being opened when the key is thrown in listening position.

953,202. DYNAMO ELECTRIC MACHINE; L. A. Hawkins, Schenectady, N. Y. App. filed Apr. 1, 1908. Synchronous alternating machines with stationary armatures, avoiding harmonics by providing a number of slots in the armature slightly in excess of the number required to receive the coils, and properly selecting the number of slots and placing the coils therein.

953,204. INDICATOR FOR INCLOSED FUSES; O. C. Hoffmann, Buffalo, N. Y. App. filed Nov. 5, 1904. A casing and end caps for the fuse, a slot in the exterior surface, an electrical conductor therein, an enlargement of the slot to receive the enlarged surface of the wire.

953,207. TROLLEY LINE CIRCUIT BREAKER; J. C. King and T. J. Reed, Roda, Va. App. filed May 6, 1909. A knife switch circuit breaker for trolley wires mounted on an insulating body.

953,218. MAGNETO IGNITION APPARATUS; C. M. P. Montbarbon, Paris, France. App. filed Dec. 11, 1908. A magneto generator comprising an arch and limbs, pole pieces extending from the limbs, and an induction coil within the arch with a dielectric layer between a limb and adjacent parts.

953,219. ELECTRIC MOTOR; H. Muller, Berlin, Germany. App. filed Aug. 29, 1907. Has two rotatable members, one fastened to the shaft and the other free to rotate and driving a ventilator.

953,236. COMBINED CLEAT AND SWITCH FOR HOUSE WIRING; H. R. Sargent, Schenectady, N. Y. App. filed Sept. 19, 1908. A switch having on its casing diametrically opposite lugs with transverse parallel openings for the line and intersecting openings.

953,243. SIGNALING SYSTEM FOR RAILWAYS; P. Utne, New York, N. Y. App. filed Sept. 28, 1908. Improvement in system making use of bonds and impedances with laminations associated with the track rails at intervals affording a path for the magnetic flux with a winding for each set of laminations in which a current is induced.

953,269. STORAGE BATTERY PLATE; F. M. Holmes, Marionville, Mo. App. filed Nov. 4, 1908. An integral body with individual receptacles for the material and intersecting reinforcing bars.

953,285. GOVERNING MECHANISM; R. B. Owens, Montreal, Que., Can. App. filed May 7, 1907. For controlling the valve admitting steam to turbines by an electrical mechanism which varies the control as the load on the turbine varies. Includes a hot wire unit connected to a generator driven by the turbine and a compensating unit responsive to changes in current flow with a member acted upon by both units for controlling the valve.

953,301. LIGHTNING ARRESTER; J. C. Seaman, Collinwood, Ohio. App. filed Oct. 30, 1907. Makes use of two choke coils enclosed in a base, with their two ends connected and their outer ends extending without the base to connect them to the line and a grounded terminal separated from the terminals of the coils.

953,306. ELECTRICAL CONTACT; W. F. Taylor, Brookline, Mass. App. filed Feb. 5, 1907. For a contact surface of platinum to reduce the amount of platinum used by securing a thin disc of platinum to the main conducting member by means of flanges overlying the edge of the disc.

953,354. SNAP SWITCH: G. E. Stevens, Lynn, Mass. App. filed Sept. 16, 1908. A rotary snap switch with a spiral spring, a regularly movable and rotatable catch plate attached to one end of the spring, an annular stop plate and a switch blade carried by the catch plate.

953,361. MERCURY ARC RELAY; J. B. Taylor, Schenectady, N. Y. App. filed Sept. 17, 1907. For telephone and telegraph lines, the relay including a vacuum receptacle, a vaporizable cathode such as mercury and two anodes with means for deflecting the arc stream from one or the other anode.

953,362. CLUSTER SOCKET; J. C. Tournier, Schenectady, N. Y. App. filed July 21, 1908. Avoids danger of breaking the porcelain ring in screwing up the parts by providing between the ring and the body a gasket.

953,366. SINGLE PHASE COMMUTATOR MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 4, 1908. A series motor with an armature winding having a commutator and inducting and exciting windings, the latter being in series with one of the other motor windings and a phase convertor whereby a shunt characteristic is superposed on the series characteristic of the motor.

953,369. ELECTRICALLY CONTROLLED SWITCH; E. R. Carichoff, Schenectady, N. Y. App. filed Dec. 2, 1908. A fixed contact, a movable contact, an actuating member and a magnetizing coil for producing magnetic adhesion between the actuator and the movable contact.

953,393. RESISTANCE UNIT; L. F. Parkhurst, Pittsfield, Mass. App. filed Dec. 9, 1908. Resistance unit for electric heater, consisting of a grid having integral members short circuiting sections thereof.

953,404. LIGHTING SYSTEM; M. Unger, Schenectady, N. Y. App. filed Jan. 10, 1907. For street cars in which a plurality of lamps are connected in series, with a regulating lamp inserted, an electromagnet in shunt with the series of lamps and a vibratory conductor automatically varying the voltage across the regulating lamp to maintain constant current in the other lamps.

953,415. SAFETY SWITCH; M. Fuss, Berlin, Germany. App. filed April 13, 1906. A circuit breaker with movable contacts, an operating member with a latch for detachably connecting one of the contacts with the operating member operated by an electromagnet.

953,420. REVERSE CURRENT RELAY; E. M. Hewlett, Schenectady, N. Y. App. filed Sept. 17, 1907. A relay with a coil and two armatures included in the magnetic circuit thereof, one polarized and the other responding to excess current through the coil.

953,442. TELEPHONE ATTACHMENT; T. W. Small, Cleveland, Ohio. App. filed Sept. 10, 1907. An attachment for desk telephone which normally depresses the switch hook with a member adapted to carry the receiver bearing down against the switch hook which, when elevated, releases the switch hook.

953,466. ELECTRIC SWITCHBOARD; W. M. Hyman, New York, N. Y. App. filed July 8, 1905. For the distribution of current from main busbars to feeders, consisting of a face wall with perpendicular vertical panels at the rear and busbar supported by the panels.

953,468. VARIABLE SPEED CONTROLLING DEVICE FOR ELECTRIC MOTORS; S. H. Keefer, Plainfield, N. J. App. filed Oct. 13, 1909. For printing presses and the like for reciprocating the bed, the switch having a series of contacts and a movable member and a cross head which can be adjustably connected to the member for adjusting the angle of the cross head relatively to the member.

953,498. COMBINED SPARK COIL AND INDICATOR; J. V. Thorndike, Randolph, Neb. App. filed Oct. 23, 1908. Discloses the condition of the coil by means of an indicator connected with the movable armature when the spark coil is energized.

953,550. TELEGRAPHIC APPARATUS; H. E. Powell, East Oakland, Cal. App. filed Apr. 29, 1908. A main line sounder to be operated by weak currents. Details.

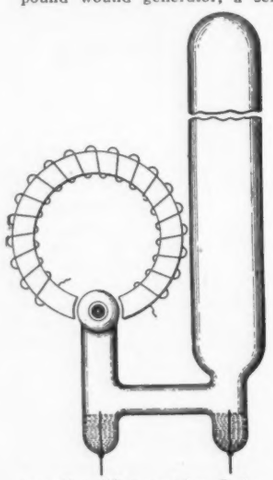
953,558. CUT-OUT; J. L. Smith, Alvord, Tex. App. filed July 31, 1909. A manually operated switch throwing the telephone main outside of the dwelling to ground or cutting it in.

953,574. COOLING OF INCLOSED DYNAMO-ELECTRIC MACHINERY; P. Amsler, Baden, Switzerland. App. filed March 27, 1909. Cools dynamos by circulating air through the machine and through a special refrigerator outside of the machine.

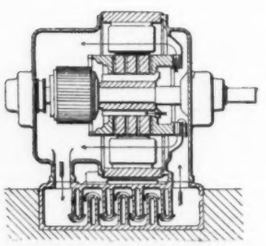
953,575. ELECTRICAL SIGNALING APPARATUS; H. W. Aylward, Brooklyn, N. Y. App filed Dec. 10, 1908. A step-by-step receiver with a plurality of electromagnets and crankshaft, the magnets being operated successively with means for indicating the partial rotation of the shaft.

953,579. CLAMP FOR ELECTRIC WELDING MACHINES; G. E. Barstow, Lynn, Mass. App. filed May 11, 1907. A work clamp having a pivotally mounted member for operating the jaw and an eccentric forming a pivot for supporting the member.

953,584. LIGHTING SYSTEM FOR SELF-PROPELLED VEHICLES; H. J. Bishop, Riverside, and J. K. Delano, Jr., Chicago, Ill. App. filed May 3, 1909. Electric lighting for automobiles using a compound wound generator, a series winding opposed to the shunt, a



953,361.—Mercury Arc Relay.



953,574.—Cooling of Enclosed Dynamo Electrical Machinery.

lamp circuit, an adjustable circuit for bridging variable members of the series winding.

953,598. VAPOR ELECTRIC APPARATUS; J. T. H. Dempster, Schenectady, N. Y. App. filed Jan. 14, 1908. For sealing wires in the walls of glass or porcelain vessels, the walls being provided with co-operating electrodes on opposite sides for conducting current into the vessel through the wall when the wall is heated.

953,601. METHOD OF TREATING ELECTRODES; L. H. Flanders, Edgewood Park, Pa. App. filed Feb. 23, 1909. For repasting worn-out battery plates by placing the plate upon a moisture removing bed and then working liquid with active material in suspension through openings in a wall of the plate.

953,635. WIRELESS TRANSMITTING SYSTEM; J. Muth and C. F. Heinkel, Cleveland, Ohio. App. filed Sept. 25, 1908. The source of power is conductively connected to the oscillator circuit and inductively to the radiator circuit.

953,640. BATTERY HOLDER SYSTEM; G. L. Patterson, New York, N. Y. App. filed Mar. 5, 1909. For holding a group of cells comprising two terminals with a connector and a common circuit closer for one set of connectors.

953,678. TEST CLIP; A. T. and C. H. Luther, Providence, R. I. App. filed April 14, 1909. For making a connection with an insulated wire to be tested. Instead of removing the insulation, provides a clamp carrying a needle which can be forced through the insulation into contact with the wire.